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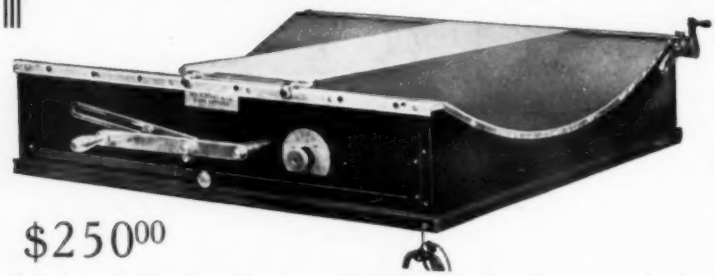

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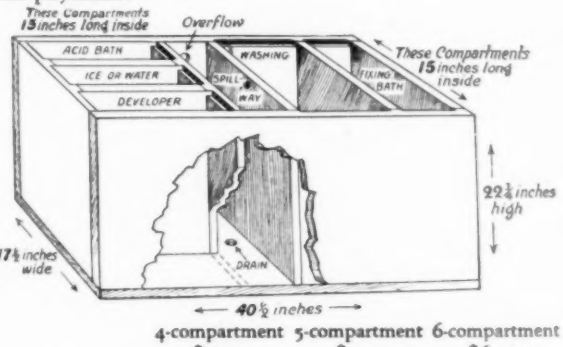

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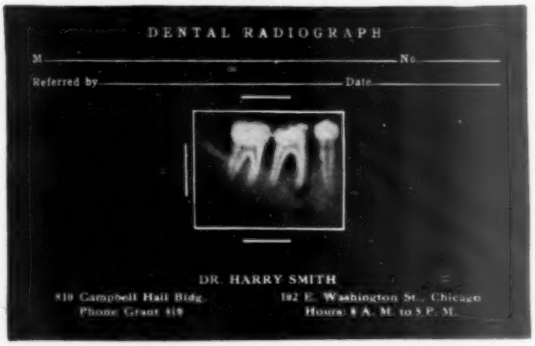

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THE AMERICAN JOURNAL OF ROENTGENOLOGY AND RADIUM THERAPY

VOL. XII OCTOBER, 1924 No. 4

EXPERIENCES IN THE PERMANENCY OF RADIOLOGICAL CURE IN CANCER

CALDWELL LECTURE, 1924*

BY GÖSTA FORSSELL, M.D.

STOCKHOLM, SWEDEN

IN this lecture I intend to present to you my experiences with the permanency of the radiological cure in cancer.

The interest in radiological scientific work is nowadays to a great extent in dealing with the problems concerning the mode of action of roentgen and radium rays and with the many important and difficult problems in the therapeutic technique.

To me, however, it seems also of dominant interest to consider the experiences we have gained in the past years, so that the development of radiotherapy may benefit by our practical experience. Radiotherapy has now been practised for nearly thirty years, and the technique in its essential parts has been developed for at least ten years. At present, however, the situation is such that there are certainly a great number of publications on the immediate results of radiological treatment in malignant tumors, but very few statistics on the final results in radiologically cured cases which have been carefully followed during a long period of observation. Also the immediate results of radiotherapy vary much in different institutions, and the indications for radio therapy are judged very differently. No theoretical speculations can here decide the matter—only practical experiences which have been critically examined. Under such circumstances it seems to me that the time has come for everybody who has large material at his disposal to try to draw the balance of the results obtained. I will now, to the extent of my power, try to carry my straw to the stack.

The most important practical questions which present themselves for our consideration in this field are, then:

Within which groups of malignant tumors has radiotherapy been able to effect a clinical cure?

To what extent has it been possible to secure a cure within these groups of tumors?

What is the degree of permanency of this cure?

What factors seem to favor or to counter-influence a permanent cure?

The material I am going to lay before you originates from the Radiumhemmet in Stockholm, a small hospital of thirty-two beds for the radiological treatment of cancer. The Radiumhemmet was founded in 1910, and is maintained by private subscription and supported by the Swedish Government and the city of Stockholm. At Radiumhemmet we have a well-organized department for the supervision of patients who are carefully followed the first few years after the cure, and are then summoned for examination at long intervals.

The greatest strength of this system of after-examination lies in the fact that the Swedish Government, by an act of Parlia-

* Delivered at the Twenty-fifth Annual Meeting, AMERICAN ROENTGEN RAY SOCIETY, Swampscott, Mass., Sept. 3–6, 1924.

ment, pays the travelling expenses of the poor patients to and from the hospital; and by means of this, personal examination and control have been rendered possible in most cases.

CLINICAL OBSERVATIONS

There are several groups of malignant growths that nowadays might be subjected to an examination regarding the final results; but only within three large groups of carcinoma, i.e., cancer of the skin of the face, cancer of the lips, and cancer of the uterine cervix, do we possess a sufficiently large number of cases which have been observed for a sufficiently long period of time, to be able to make an examination of the final results.

It does not come within the scope of this lecture to give an account of the technique employed.

I will only mention that in these groups of cancer practically all cases have been treated with radium. Only a few cases have in addition had roentgen treatment; and we use, as a rule, radium rather than roentgen rays in all cases of tumors in which a direct radiation can be applied, and always radium in our treatment of growths situated in a cavity. When radium is to be applied directly on skin or mucous membranes, we always employ prostheses of "dental mass," and a very careful application after the methods described in English by L. Edling in Volume 1 of the *Acta Radiologica*. We use a powerful screenage, generally from 2 to 4 mm. of lead, and a radium dose computed according to the tumor. The radium treatment is concluded within a relatively short time. We employ roentgen rays in cases of large tumors, in treatment of glandular metastases, and in postoperative treatment, as well as in deeply situated tumors.

I have examined the results with regard to different modes of growth and different topographical extension of the tumors, and have also compared the results in primary tumors and in recurrences. Further, I have examined the cure in different histological forms of tumors, as well as in cases with or without enlarged, regionary glands. Further still, I have examined the influence of age on the cure. And finally, I have devoted my attention to the frequency and latency of the recurrences, as well as their response to repeated radiological treatment. I have also tried to examine the real permanency of the cure obtained. I now wish to give you a brief account of my results with regard to the influence of the mentioned factors on the radiological cure and its permanency.

My report on skin cancer comprises all those cases which were treated at "Radiumhemmet" during the period from 1910 to 1915 inclusive. The entire material has been after-examined twice, in 1918 and 1923. In preparing my material I have divided my cases into two main groups: the *superficial tumors*, by which I mean tumors that are restricted to the skin and the subcutaneous tissue, and are freely movable against the subjacent tissue; and *infiltrating tumors*, by which I understand tumors infiltrating and fixed to the subjacent tissue. The prognosis is essentially different in these two groups.

Of 102 superficial tumors a cure has been obtained in 88 cases, or 86.3 per cent of the entire group. If we exclude 9 cases, which disappeared before the treatment was completed, the result will increase to 95 per cent. In the infiltrating tumors, on the other hand, the ratio of cure is only 51.4 per cent, or 54 out of 105 patients, if all cases are counted. If only the operable cases are taken into consideration, we get a ratio of cure of 67.5 per cent, or 54 out of 80 infiltrating tumors.

Considering all the cases of skin cancer, both the entirely inoperable ones and those which have not fulfilled their treatment, the absolute ratio of cure will be 68.6 per cent, since 142 out of the 207 patients have remained cured. But if we take into account only those 182 cases which were technically operable, thereby including the cases which have abandoned treatment, the ratio of cure will be 78 per cent.

It appears from what I have said that the *clinical form* of the tumor, its extension and its mode of growth play a dominating rôle in the prognosis. Also the *topographical position* of the tumor is a determining factor for the prognosis, at

least as far as the infiltrating tumors are concerned. When the tumor is situated in a comparatively smooth surface with an even subjacent tissue, as in the cheek, the chin, the temple and the forehead, the ratio of cure has been 64.5 per cent in the cases of infiltrating tumors; whereas the ratio of cure in cases of infiltrating tumors around the eye and external ear drops to

FIGS. 1 AND 2.

about 45 per cent. This is due to the technical difficulties in the application of the radium, as well as to the tendency of the tumor to infiltrate more rapidly the bony tissue when invading regions of a more complicated structure.

On the other hand, in the case of superficial tumors, the topography of the tumor does not seem to play an important rôle,

FIGS. 3, 4 AND 5.

inasmuch as the ratio of cure seems here to be the same in the different locations.

Figures 1 and 2 show a patient with an infiltrating squamous-cell cancer in the lateral part of the orbit, who was cured by radium treatment in 1913, and who is still alive and free from symptoms. Figures 3 to 5 show a patient with a large infiltrating tumor of the spinocellular type, localized in the right cheek and the right lower eyelid. The patient was cured in 1915 and lived free from symptoms for seven years. She died last year from an intercurrent disease, at the age of sixty-eight.

In reporting our cases of *cancer of the lower lip*, I have included all cases whose first treatment was terminated at least five years ago, totaling 66 cases during the period from 1910 to 1917 inclusive. In this examination of cancer of the lower lip I have followed the same principles as in cancer of the face, in distinguishing between *superficial* and *infiltrating* tumors.

There is a great difference as to the results of treatment in superficial and infiltrating tumors. Out of 40 cases of superficial tumors, 36, that is, 90 per cent of the entire group, have remained cured. But only in 9 of 26 cases of infiltrating tumors, or 34 per cent, was there a permanent cure. Of these 26 cases, however, 14 were inoperable from the very beginning. If these are not considered, the ratio of cure in the infiltrating but technically operable tumors is 75 per cent. The absolute ratio of cure for the entire group of cancer of the lower lip will be 45 out of 66 cases, or 68 per cent, when the 14 inoperable cases,

FIGS. 6 AND 7.

as well as the 6 cases that abandoned treatment, are counted. The number of cured cases out of the 52 operable ones has been 45, or 86 per cent.

Figures 6 and 7 show a large infiltrating tumor in the lower lip and cheek, before and after the treatment in 1916.

The patient remained cured for seven years until his death from cerebral hemorrhage at the age of eighty-five.

In order to obtain material as homogeneous as possible I have, in my statistics of cancer of the lip, included only cancer of

the lower lip. We have also at our disposal 20 cases of cancer of the *upper lip;* 11 superficial cases have all remained healed. Of 9 infiltrated cases, most of which were in an advanced stage, 3 or one-third, have remained healed, making thus about the same rate of healed cases as in the corresponding group of the lower lip.

Tissue for *bistological examination* has been taken in 74 cases of the skin carcinomas. As you all know, it is generally supposed that the spinocellular carcinoma shows a greater radiosensibility than the squamous-celled. My own experience shows indeed that the spinocellular carcinoma, as a rule, disappears more rapidly and more easily than the squamous-celled. But, on the other hand, there is no doubt that the histological structure, as far as the permanent cure is concerned, is of much less importance than the clinical character of the growth. All superficial cases of squamous-celled carcinoma in my material which have been histologically examined, 6 cases—and also 2 cases of spinocellular carcinoma—have been cured primarily. On the other hand, of the infiltrating type, 16 out of 33 cases of squamous-cell carcinoma (or only 48.5 per cent), and 12 out of 19 cases of spinocellular carcinoma (or only 63 per cent), have remained permanently cured. Thus, there exists in my material a slight difference in the result in favor of the spinocellular carcinoma. But, as you see, *the clinical character of the growth and not its bistological structure, has, to an essential degree, determined the result.*

It is a common experience that it is more difficult to effect cure of a tumor by radiological treatment in old and decrepit patients than in those in a better general condition. My statistics seem to support this general experience, though with the exception that the cure of superficial tumors seems fairly independent of the age and general condition of the patient.

As a matter of fact, all age-groups show about the same ratio of cure in superficial tumors of the skin. In infiltrating tumors, on the other hand, the ratio of cure falls with increasing age; so that in the age-group from thirty-three to sixty years, 22 out of 34 cases, or 65 per cent, have remained cured; in the age-group from sixty-one to seventy years, 17 out of 35 cases, or 48.6 per cent; while in the oldest age-group, from seventy-one to eighty, 15 of 36 cases, or only 41.7 per cent, have been permanently cured.

Let us now consider the differences in the results of cure in *primary tumors* and in *recurrences following surgical operation.*

Both in cancer of the face and in cancer of the lower lip the *superficial* recurrences following surgical intervention are cured to the same extent as are primary tumors.

On the other hand, *recurrences* which are *growing infiltratively* have a much poorer prognosis than primary tumors of a similar kind. Of 76 primary, infiltrating *tumors of the skin,* 45 cases, or 59 per cent, have remained cured, whereas of the 29 infiltrating recurrences following surgical operation, only 9 cases, or 31 per cent, have been permanently cured. Thus, in skin cancer the ratio of cure in the infiltrating recurrences following surgical operation is only half the ratio of that in primary, infiltrating tumors. With regard to *cancer of the lower lip,* 29 cases, or 59 per cent, of 49 primary infiltrating tumors, have remained cured, whereas only 3 cases, or 13 per cent, of 22 infiltrating recurrences after operation have been permanently cured. The prognosis of infiltrating postoperative recurrences is, therefore, very poor, when only a radiological treatment by our technique is administered.

In *cancer of the lip,* however, an important risk occurs, which, in case of skin cancer as a rule appears only in the final stages of the disease, namely the *glandular metastases.*

Out of 14 infiltrating recurrences of lip cancer that were not cured by radiological treatment 13 had extensive glandular metastases, whereas none of the 3 cured infiltrating recurrences showed any affected glands.

In 15 cases with obviously cancerous, regionary glands, a *combined surgical and radiotherapeutic treatment has been carried out.* In all, ⅔ of the cases treated in this manner have remained free from symptoms. But the period of observation is still too short to permit any definite conclusion. On the basis of the present experi-

ence, however, I think one is surely justified in advocating this combined technique of therapy in all clinically cancerous glands that are still operable. In the statistics of cancer of the lip quoted above, I have purposely included only such cases as have been treated radiologically, but not those in which a combined surgical and radiological therapy has been employed. As a matter of fact, it is not possible in these latter cases to decide with certainty to what extent the radiological therapy has taken part in the cure.

In order to study the permanency of the cure I have, as already mentioned, collected my cases of skin and lip cancer, where the treatment started five to thirteen years ago. However, the period of observation is not in all cases, as a matter of course, equal to the time elapsed since their first cure. To be able to judge the value of the results stated above, an analysis must be made on the *real duration of the cure*. With this object in view the cases may be divided into three groups:

TABLE I

CANCER OF THE SKIN OF THE FACE.

142 patients healed by radium treatment in the period 1910 - 1915.

ANALYSIS, IN 1923, OF THE DURATION OF THE HEALING.

	Age of patients at the time of treatment	Number	Time of observation after the healing: 1 year or <1 year	2-4 years	5-6 years	7-9 years	10-13 years
Group I. Patients free from symptoms and alive in 1923	51-60 years	37	3	5	1	19	9
	61-70 years	26	-	-	-	15	11
	71-90 years	7	2	-	-	5	-
	Total	70 (=49.3%)	5	5	1	39	20
Group II. Patients free from symptoms until their death from some other disease or from senile debility	51-60 years	10	1	3	2	2	2
	61-70 years	14	4	5	3	1	1
	71-88 years	23	5	13	3	2	-
	Total	47 (= 33%)	10	21	8	5	3
Group III. Patients who have been free from symptoms at an earlier examination, but have not been traced now or about whom uncertain information has been obtained	51-60 years	7	7				
	61-70 years	12	10	2			
	71-85 years	6	5	1			
	Total	25 (17.7 %)	22	3			

In the first group I count the patients whom we have followed ever since the cure and who were alive and free from symptoms in 1923. Seventy, or about half the number of the cured cases of skin cancer (49.3 per cent) belong to this group. But only 59 of these patients have remained cured without intermission. These patients have continued free from symptoms from seven to thirteen years. The other 11 patients of this group have remained cured only from one to six years after the last treatment, recurrences having appeared after a certain number of years, and these recurrences having once more been cured by repeated radium treatment.

The second large group, which comprises exactly one-third of the material, or 47 cases, includes those patients who have continued free from symptoms, but have died from intercurrent diseases or from old age. The figures will show you that about half of this number, or 23, had passed beyond seventy years of age at the commencement of their treatment. Sixteen of this group, however, have been followed from five to thirteen years. All these patients have become practically cured, that is, they have been entirely saved from their suffering for the remainder of their lives.

In the third large group I include the patients who for a shorter or longer time have been found clinically cured, but about whom only unreliable information has since been available. In the great majority, or 22 of these cases, the period of observation does not exceed one year.

If, after this analysis of the material, we proceed to consider the *duration of the cure in all cases of skin cancer* cured between 1910 and 1915, we will find that 76 cases in all, or 53.5 per cent, have been observed cured for from five to thirteen years. In 29 cases, or 20.5 per cent, the cure has been observed from two to four years. In 37 cases, or 26 per cent, we have been able to verify the cure only during one year or less.

TABLE II

CANCER OF THE SKIN OF THE FACE.

ANALYSIS OF THE DURATION OF THE HEALING

in 142 cases healed by radium treatment, 1910 - 1915.

Time of observation after the healing

1 year or <1 year	2-4 years	5-6 years	7-9 years	10-13 years
37 cases (= 26 %)	29 cases (= 20.5 %)	9 cases	14 cases	23 cases
		76 cases (= 53.5 %)		

In the cases of *cancer of the lower lip* we have observed a cure lasting for from five to thirteen years in 38 out of 45 cases, or 84.4 per cent; in 6 cases, or 13.3 per cent, during two to four years; and only in 1 case for less than one year.

TABLE III

CANCER OF THE LOWER LIP.

ANALYSIS OF THE DURATION OF THE HEALING

in 45x/ cases healed by radium, 1910-1917.

The healing has been observed for a time of:

Number of years:	1	2	3	4	5	6	7	8	9	10	11	12	13	Total
Number of cases:	1	2	1	3	10	9	6	5	-	3	2	-	3	= 45
	Time of observation				Time of observation									
	2 - 4 years				5 - 13 years									
	6 cases /13.3%/				38 cases /84.4 %/									

x/ 8 symptom-free but dead from intercurrent diseases or from old-age.

To get an idea as to the probability of a permanent cure also in those cases which have not been watched for any considerable length of time, it is necessary to examine the *frequency of the recurrences following radiological cure*, as well as the conditions under which the recurrences have appeared.

Of 156 cases of skin cancer in which a radium cure has been accomplished during the period from 1910 to 1915, 32 cases, or 20.5 per cent, have had a recurrence. The superficial and the infiltrating types of growth present a materially different frequency of recurrences. Only 11 cases, or 12 per cent, of the 92 cases of *superficial* growth have displayed recurrences. A closer examination reveals the fact that in no less than 5 of these cases have the recurrences occurred outside the irradiated area, and so they are probably not recurrences in the proper sense of the word, but are probably new growths.

In *infiltrating* tumors recurrences have developed in 21 cases, or 33 per cent, of the 64 that have been cured. Twenty of these cases have been recurrences within the original cancer area. Only in one infiltrating case has a skin tumor appeared outside the primary tumor region.

If we examine *the latent period of the recurrences*, in *skin cancer*, we will find that the majority, or 7 out of 11 of the recurrences in the cases of superficial tumors, have developed within the first year after the apparent cure. Two recurrences have appeared after three years. Two recurrences which have set in later than after three years, namely, after four and ten years respectively, have both occurred in new locations. With regard to the infiltrating types of skin cancer, the local recurrences have been distributed over a longer space of time, so that 9 cases have had a recurrence within one year, but a slightly larger number, or 10, within from two to four years. In cases of infiltrating cancer only two recurrences have occurred later than four years after the cure, namely, after six and eight years respectively.

In *cancer of the lower lip* we will find very similar figures. To get more material in studying this question I have examined not only the cases from 1910 to 1917, but all our cases of cancer of the lower lip during the period from 1910 to 1922, a total of 101 cases. Of 65 cases of apparently symptom-free superficial tumors, a local recurrence has appeared in 7, or 11 per cent of the total number. Of 36 infiltrating tumors, there has been a recurrence in 6 cases, or 17 per cent of the total number. All recurrences of either of these forms have appeared within the first three years after cure; about half the number within the first year.

From the results thus demonstrated, I think it may be gathered with a fair amount of certainty, that recurrences following radiological cure in *superficial* forms of cancer of the skin and lower lip occur only in about 10 per cent of the cured tumors; and, further, that the majority of recurrences are to be expected within the first year, or at any rate within the first three years. However, we cannot exclude the possibility of recurrences manifesting themselves later in rare cases. In *infiltrating* tumors of the skin and the lip, recurrences following apparent radium cure seem to appear in from $\frac{1}{5}$ to $\frac{1}{3}$ of the cases, and their latent period seems to be longer than in superficial cases, though the majority of recurrences set in within the first three years.

If our material is examined in the light of these results, I think we may presume that further recurrences are to be expected in some of the cases. However, considering the time of observation now elapsed, it is not probable that the number of recurrences will rise to such a figure as materially to upset the results of today.

What then are the possibilities of cure by *repeated radium treatment of the radium recurrences?* Out of the 18 cases of superficial radium recurrences (11 of which were skin cancer and 7 lip cancer) 11 cases, or 60 per cent, have been permanently cured by repeated treatment. Thus, the ratio of cure in radium recurrences is considerably lower than in primary tumors, in which about 90 per cent of cure was obtained. Of the 27 radium recurrences of infiltrating cancer (11 cases of skin cancer and 2 of lip cancer), 13 cases, or 48 per cent, have been cured by repeated treatment. Here, too, the ratio of cure in radium recurrences is much lower than it is in primary tumors of a corresponding extension.

Our final result is, thus, that in only 21 cases, or less than 10 per cent of 257 primarily radium-cured cases of skin or lip cancer, have recurrences appeared which have not been cured by a repeated radium treatment.

Judging from this experience I think we are fully justified in saying that the permanency of cure obtained by radium therapy in cancer of the skin and lower lip is quite comparable to that of surgical intervention.

I now wish to show you pictures of a patient who clearly illustrates the permanency of the radiological cure in skin cancer.

Figure 8 shows the first cancer in the world cured by roentgen rays. It is Tor Stenbeck's first cured case of skin cancer, squamous-celled carcinoma of the nose, that, after cauterization with the red-hot iron, had recurred twice. Figure 8 represents the patient at the commencement of the treatment on July 4, 1899. It was a tumor, half the size of a cherry, adherent to the subjacent tissue, and with an irregular, crater-shaped ulceration.

As Stenbeck's assistant I had the opportunity of following the treatment of the patient. In April, 1900, she was cured, with a fine scar.

I have followed the old lady ever since, during the course of twenty-five years. She is still alive and in good health.

FIG. 8.

Figure 9 shows her nice old face just as it is today.

Her case can also serve to illustrate the question of irritation doses. She got 150 small irradiations during nine months,

FIG. 9.

and yet the cancer was cured permanently, without secondary lesions.

This was the technique of that period.

The third large group of cancer in which our material permits an estimation of the final results of radiological treatment, is *carcinoma of the uterine cervix.*

My friend, Dr. James Heyman, has, by invitation of the President, read a separate paper on our final results in this form of cancer. So I will only mention the fact that we treated 505 cases of carcinoma of the cervix between 1914 and 1921. In the first five years, from 88 to 97 per cent, and in the last three years, from 63 to 76 per cent, have been inoperable or borderline cases. Of this material, 40.5 per cent of the *operable* and *borderline* cases have been symptom-free at the end of five years. Of the *inoperable* cases, 16.6 per cent have been symptom-free after five years, and 20 to 25 per cent of the remaining inoperable cases, which have not been permanently cured, have remained symptom-free for at least three years. Judging from our experience I think we may safely suppose that a permanent cure can be produced by our radium technique in about 25 to 30 per cent of all treated cases of carcinoma of the uterine cervix, which figure is quite comparable to the operative results. The course of the healing in the cases of carcinoma of the uterine cervix has led to some observations which are of general interest in considering the factors that influence the permanency of the radiological healing.

As a rule, the local recurrences have appeared within the first year, whereas glandular metastases and remote metastases have manifested themselves after several years of apparent health. Recurrences following radiological cure of carcinoma of the cervix, like recurrences following surgical intervention, are extremely invulnerable to radiotherapy. Local recurrences are subjected to hysterectomy, if the patients are suitable for operation.

A comparison between the results in those of our own cases in which radium therapy alone has been employed and the cases where a combined radium and roentgen therapy has been administered, as well as a comparison between the results in our cases mostly treated with radium alone, and the results obtained at other institutions where roentgen treatment only or a combined radium-roentgen therapy has been used, have long ago convinced me that the treatment with radium only, as a rule, is to be preferred in carcinoma of the cervix when there are no extensive glandular metastases. I have found this observation of mine confirmed by the latest statistics. I am inclined to generalize this opinion so far that I consider a radium treatment is to be preferred to a roentgen treatment in circumscribed malignant tumors, if the tumor is accessible for a direct and sufficient irradiation with radium. The chief reason for this is the comparatively limited effect of the radium radiation, which is neither attended with the same amount of risk to the surrounding tissue, nor has the same injurious effect on the whole individual, as has the deep roentgen irradiation. In the treatment of cavities, such as the uterus and the bladder, mouth and pharynx, radiumtherapy has also a very great advantage over roentgen treatment.

FIG. 10.

As to all groups of cancer other than the above referred to, we have not had a sufficiently large number of cases cured and observed sufficiently long to determine definitely the permanency of the cure. I only wish to emphasize the fact that, in our experience, *cancer of the thyroid gland*, next to cancer of the skin, lips and the uterine cervix, yields the most constant and most valuable results.

We have observed 39 of these cases during the period from 1910 to 1923, 34 of which have been inoperable cases. It seems that at least 15 per cent of these cases will remain cured after radiological treatment.

Figure 10 represents a case of malignant goiter, where, following an incomplete operation, the tumor increased rapidly

in size. The figure shows the patient, a young girl fifteen years old, on her admission, in June, 1911, one month after operation. Figure 11 shows the patient in October, 1912, when small remainders of the tumor still persisted. Figure 12 demonstrates her case in September, 1915, two years after complete relief of symptoms had been secured. She is still quite well after a lapse of more than ten years.

A new field seems here to be opened for radiotherapy.

FIGS. 11 AND 12.

My general impression is, that in all other forms of cancer (possibly with the exception of cancer of the ovaries) as a rule, only those tumors have remained cured which were of a comparatively limited size.

But *if* complete freedom from symptoms is secured, it seems that the cure, in several different forms of cancer, is permanent.

Recurrences following operations are, as a rule, less responsive to irradiation than primary tumors. In recurrences following radiological treatment the result is still less favorable.

I must point out in this connection that I have had no experience with implanted emanation-seeds, a method which has been so successfully developed in the United States. According to American reports this method has gained large fields, especially in the treatment of cancer of the tongue, bladder, prostate and rectum.

In several forms of cancer in which a permanent cure cannot be secured with our technique of today, radiotherapy has to a great extent produced lasting improvement and temporary freedom from symptoms in inoperable cancer. Radiotherapy is unrivalled as a palliative measure in cancer.

SOME FACTORS INFLUENCING THE RADIOLOGICAL CURE IN MALIGNANT GROWTHS

Our experience has shown that neither in carcinomata nor in sarcomata is the success of radiotherapy in malignant growths principally determined by the radiosensibility of the characteristic cell type.

There are probably few, if any, malignant tumors where the radiosensibility itself of the individual cells is not sufficiently great to assure a cure, if the clinical character of the case otherwise makes a cure possible. The most radiosensitive form of tumor may have the least chance of permanent cure if a rapid generalization is characteristic of the tumor in question, as for instance, in the lymphosarcomata. Rapid growth of a tumor possibly renders it more radiosensitive, though less curable. On the other hand, a tumor of but little radiosensibility, as the squamous-cell carcinoma, is, as a rule, cured permanently by a fully satisfactory technique, if it is still local and confined to the soft parts.

The biological character of the tumor and its stage of development determine the final result to at least the same extent as the degree of its radiosensibility.

A high radiosensibility in conjunction with a limited growth and well-nourished surroundings gives, of course, the best condition for a permanent cure.

In this assembly I do not need to emphasize that *the final as well as the primary cure mainly depends on the technique used,* or rather on the skill and experience of the radiologist.

A most interesting problem is *the cause of recurrences following radiological cure of growth,* and to what extent the radio-therapeutic technique is responsible for their appearance.

I cannot here enter fully into this problem. I only want to point out that, in my opinion, most recurrences are not new tumors, but are developed from remainders of the primary tumor that have been overlooked or impossible to find. Many "recurrences" are, in my opinion, due to the fact

that the case has been wrongly interpreted as being cured. I have often noticed cases of skin cancer considered as cured, in which small typical rests of the tumor have been found on the border of the tumor area. From such rests the "recurrences" arise. Many an unsuccessful treatment is, on the other hand, due to the treatment of late, reactive swellings, wrongly interpreted as cancer. This repeated treatment often results in necrosis. If any rests of the growth are then present, a radiological cure is, as a rule, impossible.

We must bear in mind that the treatment may induce a chronic dermatitis, which may lead to cancer. Personally, I have not seen a single case in which recurrences of a cancer could be supposed to have been caused by changes following radium irradiation. On the other hand, I have observed 5 cases of cancer on the basis of a roentgen dermatitis, none of which occurred in a scar following roentgen cure of a tumor.

Our experience from postoperative irradiation of cancer of the breast has taught us that latent metastases may increase rapidly if the body is debilitated by too strong an irradiation. In this way the technique of irradiation may be to blame for the development of metastases.

Neither can the eventuality be precluded that, under certain circumstances, metastases may develop when a tumor is breaking down, following irradiation.

We certainly hope, either by influencing the endocrine apparatus or by means of immunization, to reach through radiotherapy a general effect on the organism, and thereby to cure even extensive or disseminated growths. But, at the same time, we must point out quite clearly that we cannot as yet count on a permanent cure in any other cases but those in which a limited growth is still accessible to a certain appropriate dose. Further, we must emphasize that it is equally as important not to hurt the healing power of the organism, as it is to reduce the resistance of the tumor.

I am becoming more and more convinced that the normal resistance of the surrounding tissue is at least as important in radiological cure as the degeneration of the cancer cells themselves, produced by the irradiation.

My opinion is that *radiotherapy*, in favorable cases, *by weakening the tumor, gives the normal mechanism of cure a chance of overcoming the disease.*

In a former paper[1] I have stated these points of view, on which our radiotherapy has since been founded. The actual point is to weaken the tumor to a certain degree, and above all not to hurt the defending power of the organism.

In spite of all its technical improvements, *radiotherapy is still a mainly local treatment.* In all our practical work we must bear this in mind, and scrupulously avoid giving up the solid ground of our previous experience, even when facing the most important technical progress.

INDICATIONS FOR RADIOLOGICAL TREATMENT IN MALIGNANT GROWTHS

My report states the fact that a radiological treatment of growths has been successfully applied, not only in cases of inoperable tumors, but also to a large extent in operable cases. We have further seen that in certain groups of cancer a permanent cure has been obtained, and that in those groups the percentage of cured cases is quite comparable with the results obtained by surgical intervention.

Now the question arises: Is radiotherapy under any circumstances to be preferred to surgical intervention, and, if so, what are the indications for the radiological treatment in malignant growths?

In my opinion, the simple answer to this question is this: Radiotherapy is to be applied only in those cases in which it is obviously superior to surgery.

In doubtful cases, the individual conditions must decide the matter.

In inoperable cases, radiotherapy is indicated, if previous experience makes a cure or a material improvement probable.

If this be not the case, radiotherapy should not be employed, even in inoperable cases.

When radiotherapy can secure a permanent cure in inoperable cases, it is generally not the size of the growth, but its topographical situation, which pre-

[1] Hygiea. Stockholm, 1914.

vents operation—for instance, when in the pharynx, the thyroid gland, or the parametrium. In certain operable cases a bad general condition is the indication for irradiation.

In some inoperable cases, where we cannot rely upon radiotherapy alone, this therapy may be employed to change the tumor into an operable one, and then an operation can be performed successfully.

The point, however, is to do the operation at the right time.

In operable cases radiotherapy can be considered only when it will yield a materially better result than will surgery.

We meet with this condition, above all, in the borderline cases of carcinoma of the uterine cervix, in which the operation is attended with great risk; further, in the operable cases of cancer of the uterine cervix and of the thyroid gland. In these latter cases at least, the same result is gained by radiotherapy, with less mortality and morbidity than by operation.

Furthermore, radiotherapy is greatly indicated for social reasons in those tumors in which an operation involves a mutilation of the face, but where radiotherapy is able to cure definitely, leaving but very little scar. Cancers of the skin, the face and the lips belong to this category. The radiological results in these cases are quite comparable with those obtained by surgery, and the patients gain integrity of face, often of great importance for their social position.

Finally, I will mention that in my opinion, the majority of the sarcomata, except cases in which an amputation is considered necessary, are also suitable for radiotherapy. If the sarcoma does not disappear entirely, the remainder of the growth should be resected and postoperative treatment instituted. This latter procedure should also be resorted to, if the sarcoma is not reduced under radiological treatment within a short time.

Postoperative treatment is, in my opinion, indicated in cancer of the ovaries, as in most cases of sarcoma; possibly also in cancer of the uterus, cancer of the breast, and other malignant growths.

The crux is just to choose the right method of treatment, while at the same time paying strict attention to the clinical picture of each individual case, and not to strain the method beyond its limitations. The ability to limit the treatment bespeaks the master.

I have tried, as far as it is possible on the basis of our experience, to evaluate the permanent results of radiotherapy in cancer. It is with a sense of great responsibility that I have considered myself in duty bound to assert the superiority of radiotherapy in the treatment of certain operable tumors, which, in the general opinion of the medical profession, have hitherto been regarded as confined to surgery. I consider that the welfare of the patient demands that radiotherapy should be recognized and employed in every case where it can yield a better result than can other methods of treatment.

But I must accentuate the fact that irradiation of operable tumors is not to be allowed, unless an experienced radiologist with sufficient technical resources is in charge of the treatment. Otherwise, all operable cases must be operated upon.

To those who watched the first tottering steps of radiotherapy, it gives a singular and proud feeling to see its present development. The simplest results that we are now witnessing in the radiological treatment of malignant growths would, twenty-five years ago, have been regarded as pure witchcraft. We may enjoy this success, but we must realize our limitations and remember that it is still only an inconsiderable number, perhaps 15 per cent at the most, of all malignant growths that we are able to cure permanently, whether by radiotherapy or by surgery. There are enormous problems in this field still waiting to be solved—great difficulties to be overcome.

From all I have learned, I feel convinced that the radiologists of the United States will be found in the front rank in this battle against one of the most terrible enemies of humanity.

CALCIFICATION IN THE HEART AND PERICARDIUM

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THE deposition of lime salts in the pericardium ("pericarditis calculosa," "concretio pericardii," etc.) is a condition well known to pathologists. In spite of improvement in roentgenological technique, it is not being recognized frequently during life. A review of the literature up to 1923 by Case[2] shows that in only 13 instances has this condition been recognized during life. We recently recognized similar calcification in 3 patients with chronic heart disease. Subsequent post-mortem examination in 2 of these cases confirmed our findings. Roentgenograms of these hearts after removal from the body demonstrated a most bizarre and interesting localization of the calcification involving the endocardium and the myocardium as well as the pericardium. Similar studies by Klason[5] demonstrate the same process. Further roentgen studies on post-mortem hearts have made us feel that such calcification is probably not infrequent and that if attention were called to it, roentgenologists might in certain cases be able to give us this information during life.

This information would be of most value in cases of supposed adherent pericardium because this condition continues to baffle clinicians and the diagnosis is seldom made antemortem except in the most advanced cases. It would appear that if calcification could be demonstrated in a case suspected of adherent pericardium, especially if some of the other roentgenological signs[3] of this affliction were also present, (fixation, failure of the apex to descend with inspiration, etc.), there would be greatly increased evidence in favor of the diagnosis. Calcification in adherent pericardium is not a frequent finding but when present is almost pathognomonic. Wells[9] noted this as occurring 4 times in 128 cases of pericardial adhesions from a total of 1000 autopsies. If we recollect that the pericardial adhesions found post mortem are usually small and of no consequence, the importance of the evidence given by the finding of a process that has gone on to calcification cannot be overestimated.

As already suggested, other cardiac lesions are frequently associated with adherent pericardium, chiefly myocarditis and endocarditis, the latter most often of the mitral valve. In 24 cases studied by Levine[6] at this hospital, myocarditis was noted in 10 cases and endocarditis (of the mitral valve) in 9 cases. It has been stated that endocardial and primary myocardial lesions rarely become calcified to such an extent as to be visible to the roentgenologist, and yet Case 1 shows extremely marked deposits of lime salts in three of the four valves and their subjacent supporting rings, with a much smaller deposit in the pericardium. It is these three types, endocardial, myocardial, and pericardial calcification, that we wish to emphasize in this paper, with illustrative cases.

Adherent pericardium is the end-result of an inflammatory process. Most pathologists agree that rheumatic fever is the most common preceding disease, with tuberculosis, pneumonia, and syphilis next in order. One of the common late results of the reaction to inflammatory disease, no matter where the infection occurs, is the deposition of lime salts in the new connective tissue. We are of the opinion that some of the peculiar formations noted in Case 11, (Fig. 6), are due to the greater intensity of the inflammatory reaction in the fat deposits in the sulci and along the vessels, fat being notoriously unresistant to infection, necrosis, and calcification. Where the deposits are largely endo- and myocardial, (Fig. 2), we must assume preceding inflammatory disease that attacks these tissues specifically (Case 1, rheumatic fever).

The material available for study would seem to indicate that the deposition of lime salts in relation to the heart and pericardium may be roughly classified as follows: (1) Calcification in the pericardium

itself—this is the simplest form and must represent the healed stage of a preceding infection. (2) Calcification in both the pericardium and myocardium (as in Case 11)—apparently subsequent to an infectious process with a specificity for muscle, since in this type of case we may have no lesions in the endocardium. (3) The deposition of calcium salts in the region immediately underlying the larger valves—this is the reaction we would expect following rheumatic fever.

The accompanying plates demonstrate examples from all three groups and should encourage all roentgenologists to be watchful for any such shadows in their routine heart and thoracic work.

Case 1. (O. H.) A–23–36, American housewife, aged twenty-six.

Complaint. Shortness of breath.

Family History. Unessential.

Past History. Always healthy until present illness.

Present Illness. Sixteen years ago, at the age of ten, the patient had an attack of acute tonsillitis followed by acute rheumatic fever. Examination at that time showed fever and rapid pulse, an enlarged heart, and a systolic thrill at the apex with a harsh systolic murmur. A short diastolic murmur was heard along the left sternal border. Collapsing pulse, enlarged, tender liver, and inflamed elbow and wrist joints were present. A to-and-fro friction rub was present, and later, dullness and bronchial breathing appeared over the left lung posteriorly. She recovered from this attack, but had recurring tonsillitis and rheumatic fever almost every year until 1920, when tonsillectomy was performed. During this time there were several periods when she was kept in bed because of dyspnea and precordial pain. In October, 1922, she noticed increasing dyspnea, enlargement of the abdomen, and swelling of the legs. There was no improvement with rest in bed at home, and she was admitted to the Peter Bent Brigham Hospital on Dec. 12, 1922.

Physical Examination. Physical examination showed an undernourished young woman, orthopneic, and with marked cyanosis of the face, lips, and fingers. The chest wall bulged forward slightly over the precordium. The heart was tremendously enlarged. All over the precordium there was an almost continuous thrill. The heart rhythm was absolutely irregular, rate 76 at the wrist. Over the entire precordium systolic and diastolic murmurs were heard, replacing the heart sounds. Abdomen distended with fluid. Liver enlarged, and edema of sacrum and legs was present. The fingers were definitely clubbed.

Roentgenogram of the heart (Fig. 1) showed marked cardiac enlargement with prominence of the left and right auricles and a prominence in the region of the conus arteriosus. There were areas of increased density in the region of the auriculo-ventricular septum strongly suggesting calcification. Electrocardiograms showed auricular flutter. Her general condition improved slightly and cyanosis became less marked. Discharged Dec. 23, 1922. While at home she gradually became more dyspneic and was confined to bed.

Reentry March 21, 1923. Examination showed no change in the physical signs. Karrel diet, theocin, and digitalis resulted in no diuresis. Pulse ranged between 50 and 80. On April 3, she suddenly became intensely purple and died almost instantly.

Autopsy, April 3, 1923. The examination showed a large accumulation of fluid in the abdominal cavity, pleural cavities free, and marked fibrous mediastinitis.

Pericardial cavity: The pericardial cavity is completely obliterated. There are definite areas of calcification scattered over the heart. Most of the tissue is fibrous. The pericardium is adherent externally both to the sternum and the lungs.

Heart: The heart with attached pericardium and portion of diaphragm weighs 1020 gm. There is a septum defect in the membranous portion of the interventricular septum measuring 3 by 2 cm. The aortic valve is perfectly normal. The mitral valve shows both leaflets calcified and rigid. There is calcification in the papillary muscles. Tricuspid valve is markedly thickened on the internal leaflet. This leaflet has a definite anomaly as far as the chordae tendineal and papillary

muscles to which these chordae tendineal are attached are concerned. The chordae tendineal pass through the defect in the membranous septum and are attached to the papillary muscle in the left ventricle. Pulmonary valve is markedly stenosed and calcified.

The remaining organs show chronic passive congestion.

Anatomical Diagnosis. Congenital heart disease (interventricular septum defect); anomaly of tricuspid valve; tricuspid insufficiency and stenosis; mitral stenosis; pulmonary stenosis; adherent pericardium; fibrous mediastinitis; ascites; anasarca; arteriosclerosis; calcification of the pericardium; calcification of papillary muscle.

FIG. 1. Case 1. Oblique view, exposure 1/10 second with 80 ma., double screens and Speed films, showing poorly defined areas of calcification over both auricular regions and along the A-V. ring.

FIG. 2. Case 1. Post-mortem roentgenogram of heart shown in Figure 1. Letters placed at the various valves: A, aortic valve; P, pulmonic valve; M, mitral valve; T, tricuspid valve; S, septum defect.

Following the autopsy, stereoscopic films were made of the excised heart and attached pericardium (Fig. 2).

Case II. (H. L.) A–23–103, aged forty-three.

Complaint. Shortness of breath.

Family History. Unessential.

Present Illness. Patient first entered the hospital May 7, 1923, complaining of shortness of breath. He had noticed increasing dyspnea for seven years before this admission. Just previous to entry, the dyspnea had been associated with the slightest exertion, and was accompanied by a sensation of vertigo and nausea but no vomiting.

Physical examination showed marked cyanosis, emphysematous chest with flaring costal margin, heart not enlarged or otherwise abnormal except for reduplication of the second sound at the base. Blood pressure was 110/80. The veins over the neck, arms, legs, and scrotum were markedly dilated, tortuous, and thickened. Fingers were clubbed, and there was a brawny edema of the ankles.

Roentgen examination (Fig. 3) of the chest showed "high diaphragm with limited movement. There were large calcified plaques in both pleura, larger on the right. The heart shadow seemed definitely enlarged." The vital capacity was 44 per cent of normal. Wassermann reaction was negative. Routine clinical pathology showed nothing remarkable. When given oxygen, his cyanosis cleared up and he felt much better. The general impression of the men who saw him was

that he had a diffuse fibrosis of the lung and a weakened myocardium. He was discharged to the out-patient department improved.

Following discharge he returned to his previous employment as a baker and has continued at his work most of the time but has still had cyanosis and shortness of breath. This has been steadily increasing, and he has noticed that his abdomen has gradually increased in size, and for the past two weeks his shortness of breath has been very much worse. Because of

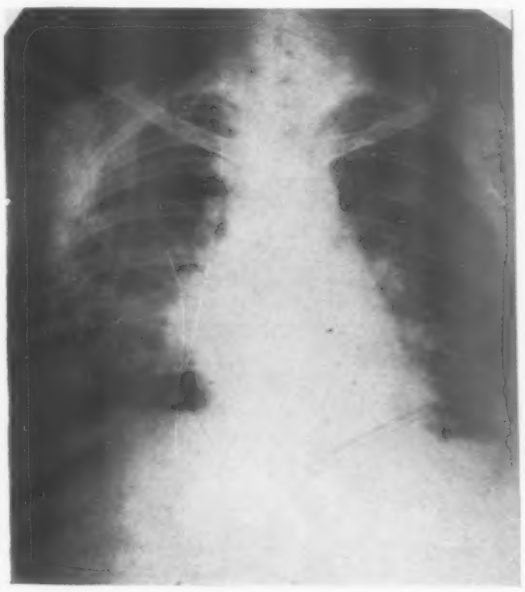

FIG. 3. Case 11. Instantaneous chest film. Note calcification on diaphragm (left) and in pleura (right) and compare cardiac shadow with Figure 6.

increase in all his symptoms, he reentered the hospital.

Physical examination Sept. 27, 1923. There is marked cyanosis of the face, hands, and especially of the lower extremities. The liver can easily be felt. There is pitting edema of the lower back. With change in position the apex impulse remains absolutely fixed. No pulsus paradoxus. The superficial veins of the neck, although markedly distended become more so on deep inspiration. Heart action is slow and regular. At the apex three definite sounds are heard, the extra one being a little closer to the second than the first in diastole. No murmurs. Heart is enlarged on percussion to the left. There is slight clubbing of the fingers. The clinicians felt that this patient was developing adherent pericardium in addition to pleural changes observed on previous admission.

Roentgen report Sept. 27, 1923. A reexamination fluoroscopically showed slight descent of the apex, limitation apparently

FIG. 4. Case 11. Photograph of heart, anterior aspect, showing area denuded and freed at operation, and the fragments removed. Note portion of diaphragm adherent to heart at the apex.

being due to the limitation of the diaphragm. There was a crescentic area of increased density, suggesting calcification in the pericardium, not well shown on the films.

Special Examinations. Vital capacity 34 per cent of normal at two examinations, 27 per cent of normal once.

Roentgen report Oct. 30, 1923. A 7 ft. film of the heart shows slight cardiac enlargement with a rounded prominent right auricle and a straight left border. The latter is similar to that seen in adhesive pericarditis. Measurements are: Mr. 5.5, Ml. 10.1, Gt.Vs. 7.1. Internal diameter of the chest 29.4 cm.

From Sept. 26 to Oct. 26, 1923, the patient's condition changed but little except for a period of ten days when, with the onset of fever, all his difficulties increased. With the subsidence of fever and the improvement in general condition, operation was decided upon. The outstanding clinical feature had been great dilatation of the superficial veins all over the body, and this even when the heart had stopped fibrillating and was acting normally led us to believe that there was some mechanical obstruction probably at the entrance of the cavae. In view of the obvious pericardial involvement and the possibility of mechanical obstruction, exploratory operation seemed advisable and was gladly accepted by the patient and family.

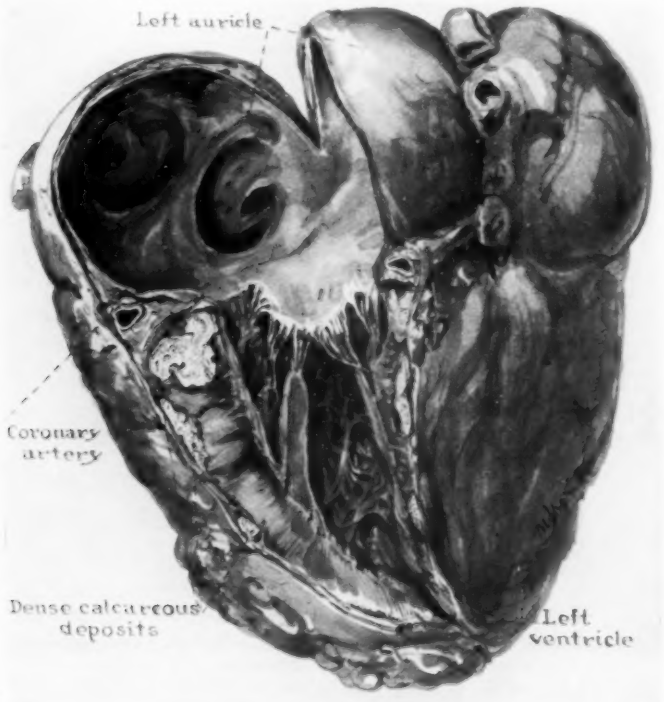

FIG. 5. Case II. Drawing showing calcification not only underlying the epicardium but in dense masses at the upper limits of the ventricular myocardium.

Operation Nov. 1, 1923. Ether anesthesia was given by the Connell forced vapor machine through a nasal tube. Exposure by means of median sternotomy, (Duval Barasty). The pericardium was adherent to the sternum by light fibrous adhesions. Calcification was found including diaphragm, pericardium, and myocardium. The pericardial space was obliterated. The anterior part of the heart was denuded of a thickened and calcified pericardium with great difficulty, the calcification necessitating the use of rongeurs. This process was continued as far to the right border as seemed safe, and on the left side until one could just see the left ventricle. Towards the apex the dissection became extremely difficult; the pericardium was very friable, and the calcification was found to extend actually into the heart muscle for some distance. We had hoped we might entirely free the attachment of heart to diaphragm, but it soon became obvious that the diaphragm, pericardium, and heart muscle were all one solid piece. An attempt was then made to get around this, but innumerable difficulties in the way of approach, exposure, and dense adhesions prohibited. Under the strain of this procedure the heart

action suffered. Contractions became less vigorous, remittent, and the systolic pressure began to fall until it reached 80 mm. Hg. One-fourth of one c.c. of a 1–1000 solution of adrenalin was then injected into the right heart. Within a few seconds the heart responded vigorously and the pressure rose in a period of 5–10 seconds to over 135 systolic. The contractions of the muscle became vigorous, active, and extremely encouraging. However, the task of continuing the decortication became impossible and closure was decided upon. The wound was closed after removing the lower half of the sternum and the fifth and sixth costal cartilages to prevent adhesions of the heart to the bony chest wall. At the close of the operation the blood pressure was 80 systolic, 50 diastolic.

The operative recovery was fairly satisfactory. By the next morning, however, a rapid failure of the circulation set in. The systolic blood pressure fell to below 50. Patient was kept alive with bleeding, caffein, and adrenalin for 24 hours. Intravenous glucose and bicarbonate of soda were given to combat acidosis. Just before death, bleeding and intracardiac injections of adrenalin failed to bring the patient back.

Autopsy Nov. 3, 1923: The examination showed no fluid in the pleural or abdominal cavities; there existed dense, tough adhesions between the greater portion of the inferior aspect of the diaphragm and the upper surface of the liver. The pleural cavities were entirely obliterated by very dense, old, fibrous adhesions in which there were firm plaques of bone-like consistency.

Pericardial cavity: This is entirely obliterated by old fibrous adhesions. The ventricles are surrounded externally and posteriorly by a jacket of firm material of bony consistency. Anteriorly this bone-like jacket is missing, only one small fragment remaining on the anterior aspect of the right ventricle.

Heart: The specimen consists of a heart with pericardium and attached diaphragm. On the anterior surface and right surface the pericardium has been partially removed. The exposed heart has attached to it dense, calcified plaques just posterior to the right border and in the middle of the right ventricle wall anteriorly (Fig. 4). There is much rather friable adherent material which is probably partially organized fibrin. The remainder of the heart is imbedded in much thickened pericardium. Apparently the surface covering the whole of the left ventricle is calcified, possibly ossified. Also the whole of the posterior surface is similarly invested in an unyielding investment of bony

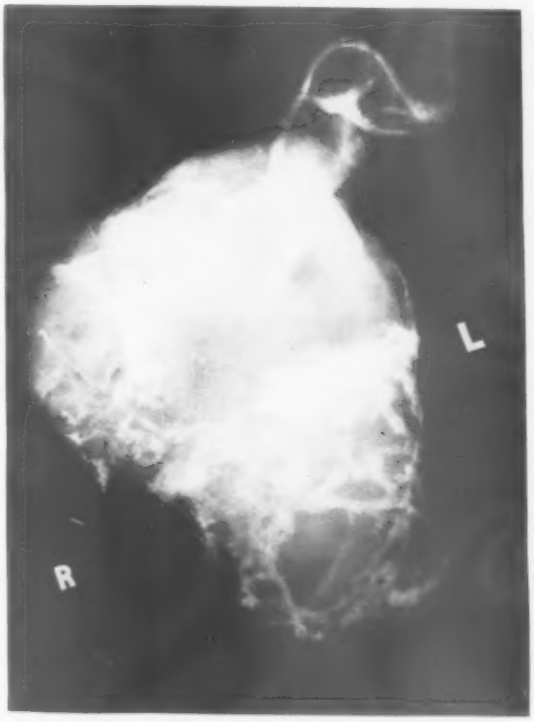

FIG. 6. Case 11. Shows distribution of calcification. Note that it is more generally distributed throughout the ventricular portion of the heart muscle.

hardness. The calcification or ossification is chiefly over the ventricles. The auricles show so much thickening of the pericardium that they are not pliable. At the apex of the heart the pericardium is fused with the diaphragm and here also there is a large, calcified plaque 15 cm. in diameter. The tricuspid valve is normal. The mitral valve readily admits two fingers, but the base and anterior segment of the valve overlies a material of bony hardness. There are large masses of calci-

fied and presumably ossified material replacing the myocardium just below the auriculo-ventricular groove (Fig. 5). On cross section this mass which underlies the mitral valve segment is 2 by 1 cm. Below this there is similar presumably ossified material between the two layers of pericardium. Two-thirds of the circumference of the right auriculo-ventricular opening is made rigid by this annular deposit of ossified material. These findings

Anatomical Diagnosis. Chronic fibrous pericarditis with calcification; chronic myocarditis with calcification; chronic fibrous pleuritis with calcification; chronic fibrous perihepatitis with calcification; chronic fibrous splenitis with calcification; chronic passive congestion of lungs and liver; central necrosis of liver; arteriosclerosis.

Following the autopsy, films were made of the excised heart and attached pericardium (Fig. 6).

FIG. 7. Case III. In this case the calcification was confined to the pericardium. It is concentrated in the region of the A-V. ring.

FIG. 8. Case IV. Single dense plaque confined to the pericardium.

are probably the end-result of a fibrinopurulent pericarditis with involvement of the myocardium. We are inclined to believe that the calcification of the myocardium just below the auriculo-ventricular ring may be accounted for by vascular lesions due to direct invasion of the blood vessel walls by the infection. We have frequently noted that this portion of the myocardium is most susceptible to degenerative changes in pericarditis. Thrombosed blood vessels in the myocardium do occur as a result of pericarditis.

Case III. A–23–71. American housewife, aged seventy-one.

Past History. Patient under observation in hospital since 1916.

Family History. Husband died of pulmonary tuberculosis three years after marriage.

Present Illness. The diagnosis of pulmonary and cervical glandular tuberculosis was first made in 1916. Heart examination negative except for slight systolic murmur at that time. Wassermann test was negative. In 1920 the cardiac

murmur was increased in intensity. From 1921 to 1923 there occurred breaking down of the axillary and cervical glands with chronic discharging sinuses. Tubercle bacilli were found in tissue removed from these areas. In September, 1923, the left leg was amputated for tuberculosis of the ankle joint. Death in November, 1923, from "pneumonia."

Roentgen examination was made of the excised heart and demonstrated definite calcium deposition (Fig. 7).

CASE IV. H–22–68, male, aged sixty-nine.

History. Death was due to perforation of a pyloric ulcer. The only clinical history available is that in the autopsy record which states that the patient had a history of gastric distress for about six weeks. Death was preceded by signs of cardiac failure for twenty-four hours. Previous roentgen studies had shown some pyloric obstruction which had been diagnosed as both cancer and ulcer. The question of terminal perforation had been raised.

Autopsy Findings. The pericardium contained no free fluid, there were a few adhesions in the posterior wall; the heart was small, extensively infiltrated with fat, and contained an increased amount of epicardial fat, particularly along the course of the coronary vessels. Approximately one-half of the left ventricle was encased in a solid mass of calcified material representing apparently a healed fibrinous pericarditis. Similar numerous calcified plaques were noticed over the surface of the right ventricle and both auricles. The valves as examined from above showed no abnormalities.

Anatomical Diagnosis. Peritonitis; perforated pyloric ulcer; old pericarditis with calcification; fatty myocarditis; generalized arteriosclerosis; chronic vascular nephritis.

Roentgen examination of the heart post mortem showed definite calcium deposits (Fig. 8).

CASE V. This case has just recently been seen by us and the diagnosis made by roentgenoscopic examination of calcification in the region of the mitral valve. There are no clinical or roentgenological signs of adherent pericardium, and no evidence that the calcification has any particular significance. As it has not been confirmed, we are not including it, except to mention it in passing.

DISCUSSION

These 4 cases demonstrate calcium deposits in the heart and pericardium. The etiological factor was without doubt rheumatic fever in Case I and tuberculosis in Case III. The condition found in Cases II and IV may have been caused by an antecedent pericarditis. The etiological factor probably plays a part in the localization of the process.

Thus in Case I, the process is general, involving pericardium, myocardium, and even the subendocardial tissue on the valves. (There are muscle fibers in the valves, and the primary reaction here may take place in this element, not in the endocardium.) It is known that in rheumatic fever the myocardium, endocardium, and pericardium may be involved. Thus Case I with a history of rheumatic fever and with such a generalized process undoubtedly had this infection as its etiological factor.

In Case II the process involved the pericardium, the diaphragm, and the heart muscle. The valves were strikingly normal, and in sharp contrast to the almost bony muscle of the adjacent ventricle. The process in this case is distinctly and primarily a pericardial and myocardial lesion. The adhesion to the diaphragm is without doubt secondary to the primary pericardial reaction as the inferior surface of this structure was quite free. Here we have no etiological factor in the history, but the history itself was not reliable. The patient was a Russian Jew and recalled little of his early life. Possibly the process represents the end-result of a healed pneumococcus infection. Such infections are far more common than usually recognized. The fact that the valves are uninvolved militates against the diagnosis of rheumatic fever and there is no evidence of tuberculosis.

The history of tuberculosis and the presence of this infection elsewhere seem to justify our placing Case III in the category of healed tuberculous pericarditis even in the absence of histological study. The confinement of the lesion here to the pericardium and the epicardial fat is to be expected because in this disease the myocardium is not usually involved, thus separating this type of case from that caused by rheumatic fever or septic pericarditis.

Case IV showed isolated areas of pericardial disease. It seems as if this process must represent the late stage of healing of infection.

Unfortunately full clinical data could not be obtained on this case.

All 4 cases show a sufficient amount of calcification to hold out a hope that careful roentgenological examination might permit a recognition of the condition during life. In the first 2 cases, which we had the opportunity of examining during life, we did recognizt that there was calcification. In one case this finding was of great assistance in determining on operation.

In view of the favorable results following the operation of cardiolysis and excision of the pericardium,[7,8] for adherent pericardium, and the great difficulty clinicians have in recognizing the condition, we would like to emphasize the importance of a most careful roentgen examination both by film and roentgenoscopy for any signs of calcification in all suspected cases. The clinical signs and symptoms of adherent pericardium in Cases I and II other than the roentgenological evidence were quite inconclusive. The diagnosis of the valvular condition, however, was extremely accurate. These cases, therefore, emphasize the great difficulty of making the diagnosis of adherent pericardium even in advanced cases and demonstrate the value of accurate roentgenological observation.

NOTE: Since this article was written 2 more cases of pericardial calcification have been reported, which with our 2 confirmed cases raises the total to 17 which have been recognized during life.[10,11]

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ROENTGENOLOGIC EVIDENCE OF MITRAL DISEASE

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THERE has been some disagreement among authorities as to what parts of the heart structure as projected on the roentgenoscopic screen, constitute its topographical outline. The studies of Holzknecht, Kraus, Groedel, Moritz, Deitlen and Assmann on the living, and the studies of Oestreich, de la Camp and Assmann on the cadaver have definitely established the roentgenologic outline of the heart. Today one can give the heart topography, roentgenologically speaking, as a well-established fact in clinical medicine.

The heart can be projected in more than one view, and each view enables us to outline different parts of the heart and its great vessels depending on the angle at which the rays strike the chest wall. We must therefore, turn the patient towards the right, towards the left and sideways while making roentgenoscopic examination in order to project the heart in different positions.

Before entering into a discussion of the roentgenologic evidence of mitral disease, we should review briefly the normal heart outline as we must have this clearly in mind before we can judge pathological conditions as shown by changed outline and form.

If we project the heart dorsoventrally, with the patient facing us, we see the heart as a pyriform shadow pulsating and merging above with the shadow of the aorta and pulmonary artery, and below, with the shadow of the diaphragm. The upper and lower boundaries cannot be sharply differentiated, while the lateral boundaries are sharply outlined by virtue of the contrast afforded by the limiting tissues of the air-filled lungs.

The right and left borders show normally a number of arches or curves which vary somewhat in clearness and extent with the position of the person whether standing or recumbent, and with the position of the diaphragm.

The right border of the heart presents from below upwards: (1) A curve with its convexity upward and toward the right, bounded below by the diaphragm and above by the superimposed curve. This curve is formed by the right auricle and is known as the right auricular curve. It may be emphasized that under no circumstances in the normal heart, does the right ventricle contribute toward the formation of this arch; (2) superimposed upon this arch there is another which is less curved and overlaps the shadow of the spine in its upward direction. This shadow is formed by the aorta ascendens. Sometimes we can observe another shadow running upward from the aorta and parallel with the right border of the spine. This shadow is formed by the superior vena cava. The German terminology for this combined shadow is "Gefassbogen" meaning the arch formed by the great vessels of the heart.

The left border of the heart is more complex and presents at least three arches or curves. The lowest curve, as may be observed by watching its pulsation on the roentgenscopic screen, is formed by the left ventricle, but at its upper end comprises the conus pulmonalis of the right ventricle. Next comes the middle curve which is short and flat and its shadow less dense than the shadow of the left ventricle. This curve is more prominent when the patient is recumbent. It is formed by the conus pulmonalis and by the pulmonary artery and is known as the arcus pulmonalis. Above this curve there is a short but more intensive shadow sharply defined against the shadow of the pulmonalis. This is formed by the aorta as it turns backward and to the left to form the descending portion of the thoracic aorta. This curve is designated as the aortic button. Between the shadows of the left ventricle and that of the pulmonalis one can frequently observe a light, somewhat triangular shadow which is more sharply defined against the pulmonalis, less so at its junction with the ventricle. This shadow is formed by the left auricular appendix. The inferior vena cava may at times be seen as a light

shadow with its concavity outward, springing from the lower end of the right auricle and merging below with the shadow of the diaphragm.

In the first oblique or left dorsoventral position where the right shoulder points forward as in the fencing position, the heart shadow shows above the aorta ascendens as it covers the descending portion of the aorta. The aorta appears

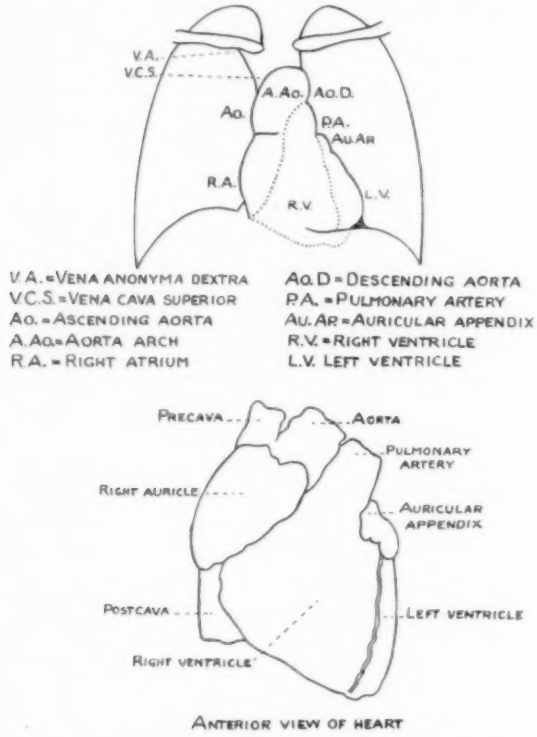


Fig. 1. Dorsoventral projection. Heart outline.

the curve formed by the left auricle and below the right auricle forming part of this boundary. This diameter is especially adapted to the examination of the left auricle. The left boundary is formed by the aorta, then the pulmonary artery terminating in the conus pulmonalis and below by the curve of the left ventricle.

The reverse first oblique diameter gives the mirror picture of the one described.

In the second oblique or right dorsoventral position, with the right shoulder

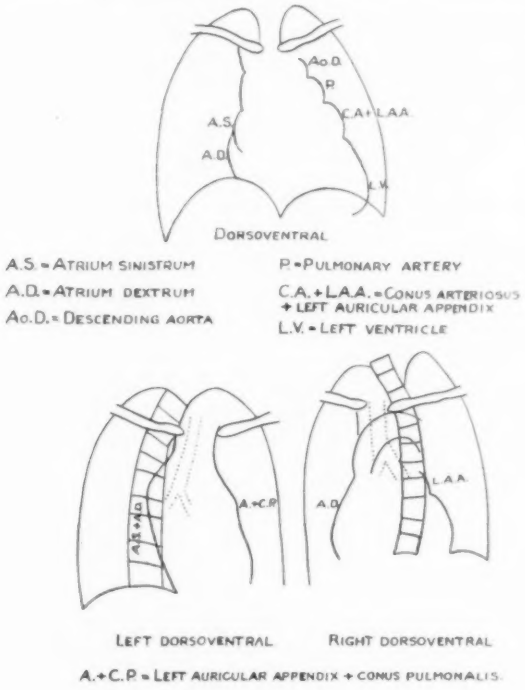


Fig. 2. Mitral heart.

short in this diameter but its lateral boundaries are clearly defined. This diameter is very important for the examination of the aorta especially in elderly people, and is therefore utilized as a routine in all heart examinations.

As the patient is turned toward the left at about an angle of 45 degrees, the spinal column moves toward the examiner's left and the heart shadow toward the right, there appears the light space of the posterior mediastinum first described by Holzknecht. The heart outline, as viewed in this diameter, shows on the right from above downward, the aorta (shortened, as stated above) then comes

directed backward and the left forward, the heart shadow presents the following particulars: the aorta appears here in its full outline; the upper part of the arch, however, is indistinct because it is overilluminated by the air in the trachea behind it superadded to that of the lung tissue. In case of aortic sclerosis the whole arch is distinctly visualized as pointed out by F. H. Hoffman. The right border of the heart is formed mainly by the right auricle, only in its lower end does the right ventricle contribute to its formation. The left border is formed above by the left auricle and below by the left ventricle. This diameter is recommended by von

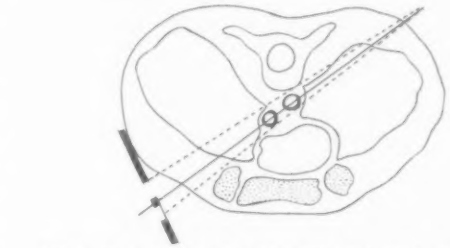
Vaquez and Bordet for the examination of the left auricle.

Of the pathological conditions of the heart which impress its form with a characteristic outline, chronic endocardial changes at the mitral valve are the most conspicuous. In outspoken cases of some duration the heart configuration is so characteristic that we have adopted for it the term mitral heart. We understand thereby a configuration which the trained eye can detect at once by roentgenoscopy or in the roentgenogram. The nature and extent of these form changes give the visual conception (within certain limits) of the physical and physiological conditions of the heart.

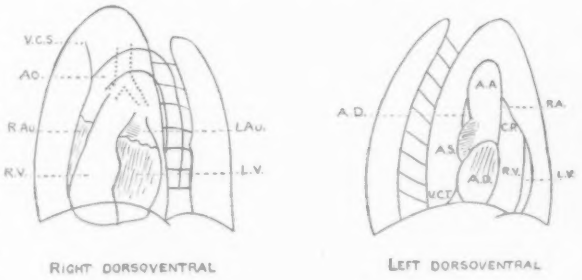
In the ventrodorsal projection the silhouette of the mitral heart gives the form of an almost straight-lined triangle with rounded edges. The broadening of the heart at the base is very characteristic and is largely responsible for this form which is to be seen even in early well-compensated cases. The heart appears long, its left border has an almost straight or step-ladder arrangement, giving the impression of having been stretched. This is especially so in mitral stenosis where there is no hypertrophy and even with atrophy of the left ventricle. Later on as the ventricles dilate, the heart becomes enlarged in all its diameters and the transverse may equal or even be larger than the longitudinal diameter, a condition practically pathognomonic of mitral disease.

The right border shows an elongated and a bulging right auricular curve. This gives the well-marked dullness on percussion on the right side of the sternum, known as Kroenig's steps. The auricular curve is also displaced upward due to the enlargement of the right ventricle. In extreme cases according to Dietlen, part of the right ventricle itself may participate in the formation of the right border of the heart. Not infrequently it is noticed that the right auricular curve is crossed by another which cuts it at an acute angle. This other curve was first interpreted by Groedel and Dietlen as an expression of a markedly engorged right auricular appendix, but Assmann has proved conclusively that this is not the case. According to Assmann, this second shadow represents the left auricle which, as it enlarges, crowds itself between the right auricle and hilus.

The left border shows the most characteristic features pathognomonic of mitral disease. It shows, as has been mentioned, a step-ladder arrangement more or less straight in its course which is due to the filling in of the constriction at the base of the heart normally seen between the pulmonary artery and the left ventricle. It had been assumed by practically all authorities, and naturally so, that the filling in of the gap was due to the engorged



DIRECTION OF RAYS IN LEFT DORSOVENTRAL POSITION (AFTER STEYRER).



RIGHT DORSOVENTRAL LEFT DORSOVENTRAL

(AFTER ASSMANN)

FIG. 3.

and enlarged left auricle or at least left auricular appendix, but as has been shown by Assmann this is not the case. What really happens is a changed relative position of the different parts of the heart structure. The heart ventricle as it begins to enlarge can only expand itself in a direction upward and toward the left and as it does so it pushes the conus pulmonalis and the pulmonary artery toward the right. In addition to this, the increase in the diameter of the conus and pulmonary artery (due to lung stasis) causes these structures to become dilated and to stand out more prominently in their contribution to the formation of the

left border of the heart. These displaced and dilated structures (conus arteriosus and pulmonary artery) fill in the gap at the base of the heart and give it its characteristic appearance. In more marked cases, especially in mitral stenosis, there is a more or less marked bulging. Usually these two structures stand out distinctly and so add another curve to the left border of the heart. At other times, however, they form one indistinguishable curve. It is to be mentioned that this newly acquired curve may be accentuated in its bulging and size by the superadded shadow of the left auricular appendix.

The aortic curve appears smaller than normal especially in cases of mitral stenosis and this is due to the enlargement of the right ventricle causing a turning of the heart on its axis upward and toward the left. Another factor is the small amount of blood reaching the aorta with each ventricular beat.

The ventricular curve is steep and long. In extreme cases according to Dietlen, this curve may be subdivided into a markedly bulging curve caused by the right ventricle and a less bulging and steep curve caused by the left ventricle.

DIFFERENCES BETWEEN MITRAL INSUFFICIENCY AND MITRAL STENOSIS

In mitral insufficiency even before any myocarditis sets in and when clinically there is no dilatation, all the chambers of the heart with the exception of the right auricle are enlarged. Later on with the onset of dilatation of the right ventricle there is also a dilatation of the right auricle. As a result, the whole heart becomes enlarged and we get the round ball-shape appearance of the heart. Due to hypertrophy of the right ventricle, we get here, just as in mitral stenosis, an elongated and drawn heart form, but unlike the case of mitral stenosis where the heart is narrow and slender (since the left ventricle does not hypertrophy and in some cases may even atrophy) we get a plump heart-form which is enlarged toward the left. This is due of course, to hypertrophy and enlargement of the left

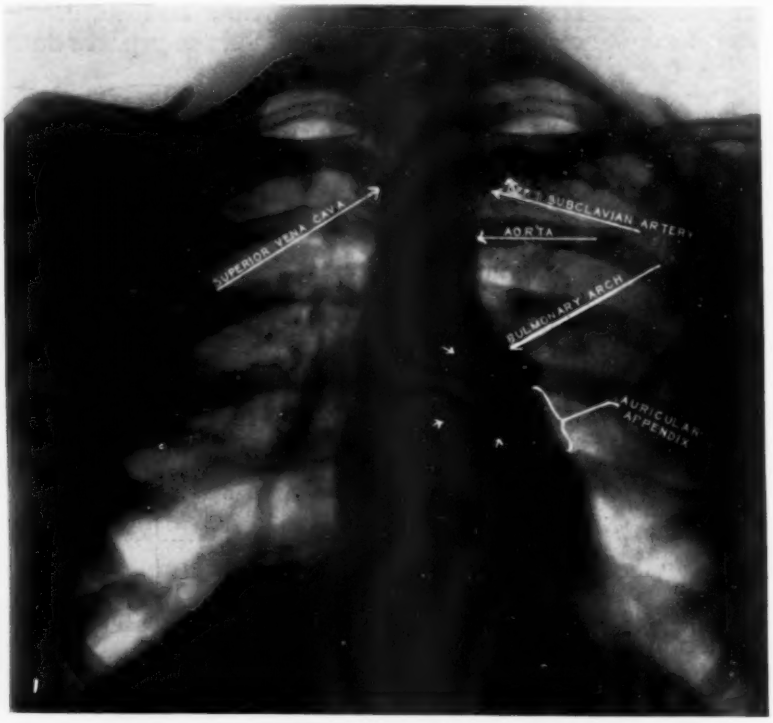


Fig. 4. Normal heart.

ventricle. The hypertrophy of the left ventricle in mitral insufficiency has also its effect on the appearance of the pulmonary curve as pointed out by Assmann. There is here just as in mitral stenosis, a displacement of the conus and pulmonary artery but here these structures are somewhat obscured by the bulging left ventricle. In early cases of mitral insufficiency we still note some of the concavity normally seen between the aortic curve and that of auricular appendix which is superadded to that of the left conus and this increases the bulging of the curve; (3) lack of hypertrophy of the left ventricle in mitral stenosis helps to accentuate the prominence of the conus curve.

PULMONARY CONGESTION

In cases of mitral disease one often finds that the lung shadow appears hazy and cloudy. This is due to congestion and

FIG. 5. Mitral heart. Filling in of gap between aortic curve and left ventricle. Bulging of conus arteriosus.

the left ventricle. As the conus and pulmonary artery become dilated this gap is filled in and may even bulge out to the left though hardly ever so prominently as in cases of mitral stenosis.

In general, one can state that the different curves on the left border of the heart are much less prominent in mitral insufficiency than in mitral stenosis for the following reasons: (1) The conus pulmonalis is much more enlarged and dilated in mitral stenosis; (2) in mitral stenosis there is often an enlargement of the left induration of the lungs by stasis and an increased amount of fluid in the lung tissue. Assmann was the first to point out the increase in the size of the hilus and its branches caused by dilatation of the pulmonary arteries. This in turn is due to the increase in pressure of the pulmonary circulation.

VALUE OF ROENTGEN EXAMINATION IN MITRAL DISEASE

(1) In doubtful cases where from the history of the case and the clinical findings

mitral disease is likely but not certain. This is the case where some cardinal signs such as accentuation of the second pulmonic or the impulse at apex are missing. In such a case roentgen examination can be of great help.

(2) In cases of well-established mitral lesion the roentgen examination gives a visual picture of the magnitude of the anatomical changes with greater precision and certainty than is possible if percussion and ascultation alone are made use of.

The degree of dilatation of the different chambers of the heart, the degree of dilatation of the pulmonary artery and the conus are visualized before the examiner in the living, as the pathologist sees them on the autopsy table. In some cases as pointed out by Dietlen, the subjective symptoms seem severer than the physical findings would warrant, and we are often inclined to ascribe them to neurosis. The finding of pulmonary congestion roentgenologically would correlate at once the subjective symptoms with the anatomical changes.

(3) Roentgen examination has prognostic value. Following up the cases of mitral lesion and observing gradual enlargement and dilatation of the heart can be done with much more certainty than percussion alone would allow. We are enabled to get a more definite prognosis and a guide to the therapeutic measures prescribed.

FIG. 6. Mitral stenosis and aortic regurgitation.

(4) Roentgen examination is of value in differentiating between primary insufficiency due to endocarditis of the mitral valve and secondary insufficiency caused by myocarditis and dilatation of the ventricles. The characteristic findings as described above would be of great help in clearing up such a diagnosis especially in early cases of secondary insufficiency before the open valve had time to cause the anatomical changes incident to this deficiency.

ULCERATIVE PULMONARY TUBERCULOSIS IN INFANTS

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CAVITY formation in pulmonary tuberculosis in the first two years of life is not exceptional. Investigators place the number from 1 out of 8 to 1 out of 3. Ribadeau-Dumas (1913) reports cavitation in 22 out of 68 autopsies, or 32.37 per cent. White and Carpenter (1909) found cavity formation in 12 out of 75 cases, or 16 per cent. Ghon (1916), in 80 autopsies on children between two and twenty-four months of age, found cavities in 43.75 per cent.

During the period of infancy, cavity formation is most common between the ages of six and eighteen months. The occurrence of cavities in infants younger than three months of age is extremely rare. However, Bergmann (1915) reports a case of advanced pulmonary tuberculosis with cavity formation in a two-months old child, whose mother died of tuberculosis shortly after its birth. In the upper part of the right lung there was a large walnut-sized cavity, besides many smaller cavities. In the upper lobe of the left lung there were two cavities.

Cavities are formed by softening and breaking down of the primary lesion or of caseous pneumonic areas (Figs. 1 and 2). Extremely large cavities occupying one or more lobes may be formed by the fusion of ulcerations in the midst of caseous pneumonia. These cavities may have caseous walls, but seldom are the walls fibrotic. The tuberculous lesions almost invariably show no tendency to heal. The clinical course is acute or subacute.

Ghon (1916) in analyzing 50 cases in the first year of life states: "Over 95 per cent of the fifty cases showed progressive tuberculosis in the form of caseous or cavernous foci, the cavities of which were often quite large. Only three cases showed signs of anatomical healing, if we are going to reckon as examples of this, not only calcification and petrification, marked fibrous shriveling of the surrounding area, and scar formations, but also a recognizable encapsulation in the form of a grey ring at the periphery." The youngest of Ghon's cases to show calcification of the lung focus and lymphatic glands, was a female aged seventeen months. From this age onward the cases increased in number. He quotes Küss (1898), who found a completely petrified lung focus in a male aged eleven months, and Giepel distinguished chalky salt deposit in caseous lymphatic glands of a female aged six months.

Honeij (1920) quotes from Lhomme the following figures on the occurrence of hemoptysis: "Rillet and Barthez do not find a single case of hemoptysis in individuals under seven years of age. Carrie found six cases; Foss, seven cases; Cadet de Gassicourt, eight cases; Mandel, fourteen cases. Henoch and Hendrick believe it is very rare in infants who have not reached the age of dentition."

Ordinarily tuberculous cavities in infants present no physical signs by which they can be recognized and it is only by the roentgenogram that an antemortem diagnosis of ulceration can be made. Not infrequently even extensive pulmonary tuberculosis at this age, with or without cavities presents meager physical signs of its existence and the extent of the involvement usually exceeds the clinician's expectations. Ribadeau-Dumas states that in 11 cases with cavities as large as walnuts, there were only 6 which gave corresponding signs even of a pulmonary lesion and states: "We find put down in the histories only once, cavernous râles, three times moist râles, two times absence of breath sounds. Not once have cavernous murmurs been noted."

The location of the cavities occurring in the first period of childhood is removed from the apices as a rule, in contrast to this region as the most frequent site for cavity formation in adults. However, in one of the cases of this group, the ulcera-

tion was at the extreme right apex. The usual site is in the middle and lower lobes centrally located or near the lung roots.

The right lung is more frequently involved. As a rule, ulceration is largely confined to one lobe, or to one side of the chest.

Within the past two years there have been 7 cases of ulcerative pulmonary tuberculosis in children under two years of age at the Cleveland City Hospital. Five out of this number have been verified by autopsy. All of these cases, except one, were examined roentgenologically. In only one case was the cavity not demonstrable in the roentgenogram. In this case the cavity was a shallow one about 1 cm. in diameter located at the extreme right apex of the lung. In only one case of this group were there physical signs of a cavity, but these signs did not appear until three weeks after the ulceration was revealed by the roentgenogram and the cavity had increased in size until it occupied the greater part of the middle and lower lobes of the right lung (Fig. 4). One case throughout the entire course of the disease presented no direct physical signs indicating any lung pathology (Fig. 5). All the rest of the cases presented physical findings in the chest which led the clinicians to suspect either bronchopneumonia or tuberculosis.

There were 6 males and 1 female. Six out of the 7 cases were colored babies. It is believed that the larger number of negroes developing cavities is due to the well-known fact that the colored race is more susceptible to tuberculosis and has less immunity against the disease than the white race. In regard to the age, the youngest in the series was six months and the oldest twenty-four months (Table 1).

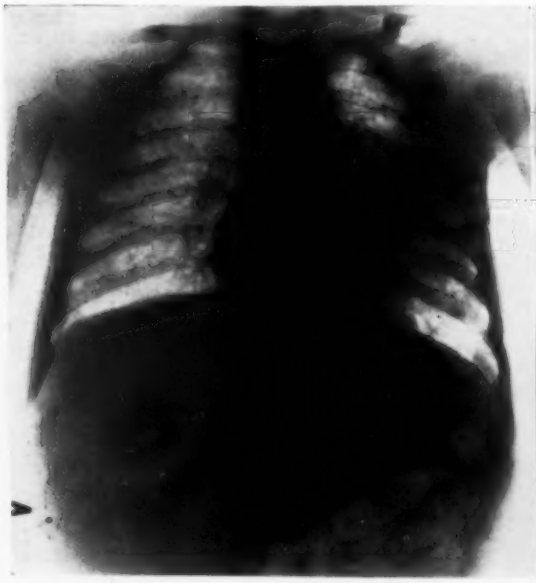

FIG. 1. Tuberculosis with tuberculous pneumonia on the left. Age, 9 months. Colored.

FIG. 2. Same case as Figure 1 (two weeks later) showing cavity formation in the pneumonic area in the left lung.

TABLE 1

AGE INCIDENCE OF INFANTS WITH ULCERATIVE TUBERCULOSIS

6 mos.	8 mos.	9 mos.	12 mos.	19 mos.	24 mos.	Total
1	1	2	1	1	1	7

The hospitalization ranged from three to fifty-six days. The intradermal tuberculin test was positive in all. In some of the cases cough was quite aggravating, while in others it was not so. It is interesting to note that there was not a single

instance of hemoptysis, although three of the cavities were of such size as to occupy an entire lobe or more (Figs. 4 and 6). Three out of the 7 developed meningitis. A roentgen chest examination of an infant with meningitis may disclose extensive pulmonary tuberculosis, thereby establishing the type of meningitis. Miliary pulmonary tuberculosis is the type more frequently found associated with meningitis.

The right lung was the site of cavity formation in 5 cases and the left lung in 2 cases. As already stated, in one case the cavity was located at the apex of the right upper lobe. In all the other cases the cavities were centrally located in the lobes of the lung. All of the cases autopsied showed single cavities. Extensive tuberculosis was found in most of the other organs, such as spleen, liver, kidneys, meninges, etc.

It may be quite difficult to make an early differential diagnosis between tuberculous bronchopneumonia and a non-tuberculous process. The presence of a widened mediastinal shadow and enlarged hilum shadows consistent with tuberculous adenitis is roentgen evidence in favor of pulmonary tuberculosis. The tuberculin test properly done is of distinct value in making a differential diagnosis. The failure of a pneumonic process to clear up in the usual time may be the first indication of tuberculosis. If cavity formation is revealed in the roentgenogram it is practically diagnostic of tuberculosis. Three cases of this group were followed by serial roentgenograms. Fusion and softening of the pneumonic areas with resultant cavity formation was strikingly demonstrated.

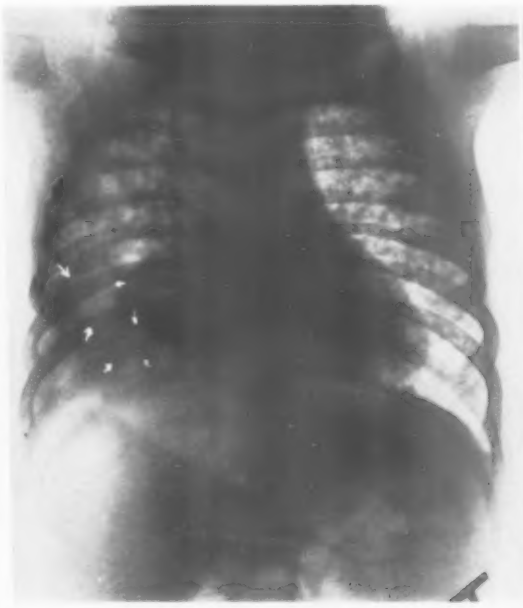

FIG. 3. Tuberculosis with cavities in the region of the middle and lower lobes of the right lung. Age, 6 months. Colored.

FIG. 4. Same case as Figure 3 (18 days later). Ulceration of the middle and lower lobes of the right lung forming a massive trabeculated cavity (verified by necropsy).

As a rule there is a marked difference in the well-being of patients with extensive tuberculous pneumonia, as compared with a non-tuberculous pneumonia. The latter are profoundly ill and present grave symptoms, while the former may show a marked disparity between the general clinical picture in comparison with the amount of pathology revealed in the roentgenogram of the chest.

The following illustrative case from the series is reported: A colored male, aged six months began to fret and cry six weeks ago. Had night sweats and has lost weight during the last two months.

Cough began three weeks ago. Baby breast fed and no known exposure to tuberculosis.

Physical examination revealed a well-developed and nourished colored baby very ill, with respirations not particularly rapid. The spleen was enlarged and soft. The percussion note was elevated in pitch on the right side of the chest posteriorly below the sixth rib. Over this area breath sounds were increased in pitch and there were occasional inspiratory râles. A few days before death a dull percussion note was elicited over the lower part of the left upper lobe, and cog-wheel breathing was audible. The day before death there was a typical band-box note over the third interspace anteriorly on the right. Two days before death the patient developed meningitis evidenced by twitching of the right side of the face, bulging fontanelles and inactive pupils; 36 c.c. of cerebrospinal fluid was removed by cistern puncture. The cell count of the spinal fluid was 40 lymphocytes and 10 polymorphonuclears. The temperature ranged from 38 to 39° C. The patient died on the 21st day after admission to the hospital.

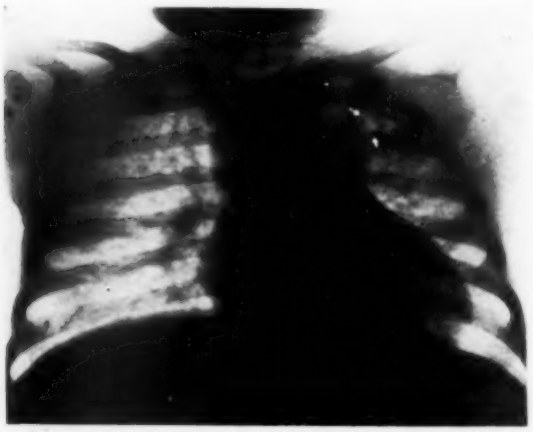

FIG. 5. Tuberculosis with a small cavity in the left upper lobe (verified by necropsy). Age, 19 months. Colored.

The first roentgen examination of the chest (Fig. 3) taken two days after admission shows coarse mottling scattered throughout the left lung and the upper lobe of the right. The lower two lobes on the right are unevenly dense. In the region of the middle lobe there is a bright area 2 by 3 cm., suggesting a cavity. Below this there is a similar area in the lower lobe which probably represents a cavity.

The last roentgenogram of the chest (Fig. 4) taken on the day before death (18 days after the first examination) shows the ulceration in the lung markedly increased. There is a massive trabeculated cavity occupying the entire right lung below the level of the third rib anteriorly.

Autopsy revealed a large trabeculated tuberculous cavity involving practically the entire middle lobe and the greater part of the lower lobe of the right lung. There was chronic tuberculosis of the remainder of the right lung and of the entire left lung with superimposed acute miliary tuberculosis. Miliary tubercles were found in the spleen, liver and kidneys. The mediastinal glands were caseous and there was tuberculous meningitis.

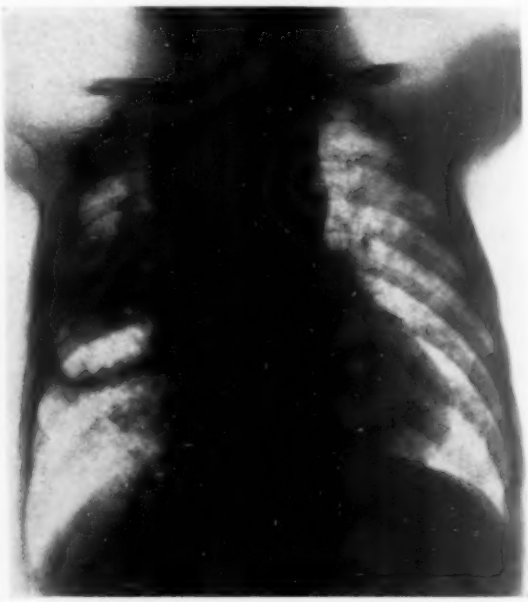

FIG. 6. Tuberculosis with large cavities in the upper and middle lobes of the right lung. Age, 9 months. White.

CONCLUSIONS

1. Tuberculous cavities occur frequently in infants.

2. The only method of diagnosis is by roentgenography.

3. It would seem that the incidence of tuberculous ulceration is higher in the colored race.

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MULTIPLE MYELOMA WITH CASE REPORT

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MULTIPLE myeloma is a specific malignant tumor of the bone-marrow probably arising from a single cell type, and characterized by multiple foci of origin, a uniform and specific structure composed of plasma cells or their derivatives, rare metastases, albumosuria, and an invariably fatal termination. The disease was first described by McIntyre in 1850. In the course of time it has been interpreted by observers under the following heads; primary multiple sarcoma of bone-marrow, senile osteomalacia, myelogenous pseudoleucemia, and Kahler's disease. The etiology, pathogenesis, and origin of albumosuria, and its relation to other tumors and pathological processes in bone-marrow still remain obscure. The tendency to limit itself to bone-marrow, and bone, and its resemblance to an infectious granuloma has been noted on a number of occasions.

Pathologically, there appear simultaneously grayish and reddish masses in the spongy bone or in the medullary canal, and as the masses grow they excite active resorption of the bone, in which there is great loss of mineral salts, with subsequent bending and breaking.

Roentgenologically studied, it is a slow-growing, malignant tumor the favorite site of which is the flat bones. The ribs, sternum, and pelvis are the chief original seats of the tumors, but the long bones are frequently involved. Other areas frequently involved are the vertebrae, cranium, femur, clavicle and humerus. The lesions are

FIG. 1. Cranium. The bones are extensively involved with the lesions. There has been no change in the size of the skull, which helps to distinguish from Paget's disease, the latter giving an increase in size of the cranial bones, together with knob-like areas of bone between inner and outer tables.

multiple and the bones are pierced by small focal spots of destruction varying in size from a small bean to a ten-cent piece. The disease does not expand the

cortex, but the gradual thinning and perforations allow pathological fractures to occur. These fractures are common and are accompanied by little or no pain. The case reported in this paper shows pathological fractures in the clavicle, femur and in four ribs on the right side. The patient was conscious only of the fracture of the femur, and the pain was only of moderate degree. Bending, twisting and complete destruction of some bones is seen. Some areas are so rarefied that it is difficult to get a clear-cut roentgenogram.

FIG. 2. Right shoulder region, showing lesions in the scapula, humerus, clavicle and ribs. There is a pathological fracture of the acromial end of the clavicle. Observe the early lesions around the glenoid cavity and more advanced ones in the shaft of the humerus. Pathological fractures of ribs are also present.

FIG. 3. Left shoulder region showing lesions in scapula, ribs, clavicle and humerus. Not so extensively involved as the right side.

This marked rarefaction gives the picture of worm-eaten timber. There is absence of bone production. After passing the periosteum, the surrounding tissues are invaded, but this invasion is very slow.

The presence of Bence-Jones' albumosuria is a helpful diagnostic point, but not entirely characteristic of myeloma. Occasionally it is found in some leucemias, myxedema, osteomalacia, carcinoma of bone and chondrosarcoma. However, it is most frequently present in myeloma and should be looked for. While metastasis to the internal organs may occur it is very rare.

The disease affects males chiefly, and usually between the fourth and fifth decades. The duration varies from a few months to several years. The early stage is detected from vague pain, caused from erosion of the periosteum or adjacent nerves, and the above described roentgenological picture is sometimes observed in the course of examination of some internal organ. Anemia and toxemia accompany the disease, the former varying from a mild secondary to the pernicious type. The prognosis is poor, and treatment is of little avail. If recognized soon enough before the lesions have obtained a multiple hold on the osseous system, roentgenotherapy in comparatively light doses is recommended. Exposures of 5 ma., with a back up of 10 in., 4 mm. Al filter, for 15 minutes will produce a diminution in the size of the tumors with a collapse of the bony capsules.

CASE REPORT

Female, white, married, aged 39. One child living and well; brother died of pulmonary tuberculosis. Patient's medical history starts from August, 1920, when she was admitted to the surgical service of the Sarah Leigh Hospital, Norfolk, Va., for amputation of the left breast for diffuse adenocarcinoma with axillary gland involvement. She made an excellent recovery from the operation and was given postoperative roentgenotherapy, with no recurrence for three years.

FIG. 4. Lower forearm and hand showing the lesions at a very early stage. Note especially the areas in the radius, second metacarpal, and carpal bones, this being against possible carcinoma, which rarely metastasizes below the elbow and knee.

In February, 1922, she complained of swelling and tenderness of the left elbow, forearm, and hand following an infected scratch on the left elbow. From February until May, 1922, multiple abscesses formed at intervals, necessitating incisions in the elbow, forearm, palm and dorsum of the hand. The soft tissues only were involved. Roentgen films of these regions showed no bone or periosteal involvement. White blood count showed a leucocytosis varying from 13,000 to 18,000; red blood count was normal; blood sugar, blood Wassermann, and urine tests were all negative.

Six months later she began complaining of pain in lower part of back, this being exaggerated on walking, and still later she complained of pain in knee, hip and shoulder joints. She was re-admitted to the hospital. General examination revealed left pyelitis, diseased tonsils, and subacute arthritis. Roentgen examination of chest, lumbar spine and pelvis was normal. The left pyelogram showed two diseased calyces. Laboratory findings of note were hemoglobin 62 per cent, red blood count 3,400,000, blood urea 43 mgm. per 100 c.c., albumin two plus. During her stay in the hospital, which lasted until January, 1923, tonsillectomy was performed, and several kidney lavages were done and on discharge the local and general disturbances had improved.

FIG. 5. Pelvis and upper half of femurs. Shows involvement of all bones and pathological fracture of right femur. Note also the extensive involvement of the left femur.

Three months later the patient returned to the hospital in a weak and anemic state. She complained of general malaise, vertigo, and difficulty in using limbs.

Laboratory findings showed hemoglobin 45 per cent, white blood count 3,000, red blood count 2,210,000; differential, polymorphonuclears 53 per cent, small mononuclears 45 per cent, large mononuclears 2 per cent. She was given a blood transfusion. She presented the clinical appearance of metastatic carcinoma involvement from previous breast condition, as she also complained of some pain in the chest. Roentgen examination of the chest revealed the first definite evidence of tumor involvement of the osseous system. At this stage there was a pathological fracture of the outer end of the right clavicle, of which the patient and clinicians were unaware, and small myeloma processes of the glenoid cavity of the right scapula, upper extremity of humerus and three ribs of the right side. It is of interest to recall that the breast pathology three years ago was on the left side. The multiple lesions above described gave the picture of multiple myeloma. Bence-Jones bodies were found in the urine. There were no metastatic lesions in the lungs or pleura. In an effort to check this condition roentgenotherapy was given, but to no avail.

FIG. 6. Early lesions in lower extremity of femur and upper extremity of fibula and tibia.

After recognizing the condition as multiple myeloma, its destructive advance through the osseous system was followed roentgenologically by the writer at the patient's home by means of a portable roentgen-ray machine. In October, 1923, she complained of pain in the right hip, and a pathological fracture, together with advanced myeloma processes was revealed. The patient at this time was bed-ridden and emaciated, but showed no evidence of metastases to the internal organs, clinically or roentgenologically, which, as previously stated, is a rare occurrence. During the

FIG. 7. Early and intermediate lesions in lower extremity of tibia and tarsal bones.

next two months she gradually became weaker and more toxic, finally going into a coma which was followed by death. Her death occurred nine months from the time the disease was recognized roentgenologically.

Consent for complete necropsy could not be obtained, but sections of the clavicle and ribs were secured and the pathological reports verified the diagnosis. The microscopic examination was as follows: numerous typical plasma cells, varying from 6 to 8 microns in diameter, round type and of fairly uniform shape; cytoplasm opaque and non-granular; small nuclei, single, no mitotic figures. Diagnosis, plasma-cell type of multiple myeloma.

The accompanying reproductions show the areas and extent involved. The lesions appear in the early, intermediate, and advanced stages, and I have demonstrated them in the cranial bones, vertebral column, ribs, pelvis, clavicle, humerus, scapula, radius, carpus, metacarpals, femur, tibia, fibula, calcaneus, and astragalus. The pathological fractures are shown in the clavicle, femur, and four ribs of the right side. Marked distortion and rarefaction is shown in the vertebrae and pelvis.

The case is unusual from both clinical and roentgen standpoints, as the literature on this condition refers to the lesions being found in the various bones at "autopsy" but seldom mentions demonstrating multiple myeloma in so extensive involvement and in all stages in a single living subject.

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OSTEOCHONDRITIS DEFORMANS JUVENILIS—LEGG'S DISEASE—WITH OSTEOMYELITIS OF THE ACETABULUM PROBABLY TUBERCULOUS A CASE REPORT

BY S. C. DAVIDSON, M.D.

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SINCE Legg of Boston in 1909 first described "an obscure affection of the hip joint" the condition has remained more or less an unsolved problem. Legg wrote of it as appearing in the young and presenting a flattening or broadening of the epiphysis of the femur. In 1910 Perthes differentiated and described the same condition so that it has been known commonly as either Legg's disease or Perthes' disease. Others describe it under the heading of osteochondritis deformans juvenilis and still others refer to it as osteochondral trophopathy of the hip joint. Whatever name one may wish to use, it is well recognized that a hip joint which presents clinical evidence leading one to suspect tuberculosis and which upon roentgenographic examination shows a flattening and mushrooming of the head of the femur without involvement of the joint, is Legg's disease or Perthes' disease or any one of the other names already mentioned.

Many observers have written on the subject and many cases have been reported, but practically little has been added since Legg first reported his cases. The disease appears in the young and runs a self-limited course, recovery occurring in from six to twelve months or more, the result being a remodeled joint with excellent function. The cases reported in the literature differ only in the extent of the involvement; otherwise the history of the progress is practically the same. One of the outstanding features of this condition is that it is very often mistaken for tuberculosis,

and the roentgenogram is accepted as the important differentiating factor.

Baetjer and Waters state: "This condition is of peculiar interest in that it affects the hip joints in the age when tuberculous infections are so frequent. Its clinical signs and symptoms are also closely akin to those of tuberculosis, but it does not react to tuberculin . . . It is frequently impossible to make a diagnosis from the clinical picture, but in typical cases the *x*-ray appearance is pathognomonic and when once seen can always be recognized . . . The lesion apparently confines itself to the epiphysis and does not involve the acetabulum directly though changes in the shape of the epiphysis of the head of the femur may later mechanically alter the acetabulum." Holmes and Ruggles state that osteochondritis deformans is revealed by flattening and mushrooming of the head of the femur suggesting tuberculosis, but without typical clinical signs. The joint is not involved. Roberts mentions that tuberculosis (as an etiological factor) has been eliminated because the joints recover with good function. Ely states that in the past, Legg's disease has often been mistaken for tuberculosis and cases of it have been quoted to swell the list of cures by some favorite treatment. The diagnosis as a rule is not difficult. Tuberculosis has more pain, more muscle spasm, greater restriction of motion and greater muscular atrophy. Riley states that the fact that two of these cases—4 cases being reported—had been previously diagnosed as tuberculosis of the hip joint emphasizes the importance of careful roentgenologic diagnosis in all cases of hip joint disease. Kirklin states: "From a number of clinics a retrospective analysis of a large series of cases formerly diagnosed and treated as tuberculosis of the hip joint, demonstrated the fact that the roentgenograms of many of these cases showed the appearance characteristic of this condition and I believe that most of the active cases which I personally have seen have been referred with a clinical diagnosis of tuberculous hip joint disease." So much emphasis is placed upon the differential diagnosis between Legg's disease and tuberculosis of the hip joint that we are apt to overlook the fact that tuberculosis may develop in a hip joint which presents the signs usually associated with Legg's disease. This occurrence has never before been reported, to my knowledge, so that the following history may be of more than passing import:

FIG. 1. Roentgenogram made on admission, August 14, 1923, showing a flattening and broadening of the epiphysis with a broadening of the neck of the femur on the right side, together with a compensatory enlargement of the acetabulum.

A. P., male, aged eight, was admitted to the Highland Hospital on August 13, 1923, on the service of Dr. Thomas Buck, with a history of recent injury to the right knee. Previous to this injury the history is of no practical consequence. At this time he had a slight limp together with some limitation of motion. A roentgen examination made on August 14 (Fig. 1) showed the right hip to be distinctly

abnormal in appearance. There was present a definite flattening and mushrooming of the head of the femur, together with a broadening of the neck of the femur and a compensatory enlargement of the acetabulum. No changes were observed which were indicative of the presence of a destructive lesion. No areas of decreased density were outlined. The blood Wassermann reaction was negative. A diagnosis of Legg's disease was made. The limb was immobilized and he was sent home.

On February 18, 1924, he was re-admitted to the hospital complaining of pain in the back and presenting a swelling over the sacral region on the right side. His illness at this time dated back about three months. He stated that he was thrown down, striking his right side against the floor. The pain and swelling dated from that time. The patient had been confined to his bed since. Upon examination it was found that the right gluteal region appeared much larger than the left and was definitely swollen. It was tender on pressure. The swelling was about three inches in diameter and situated at the uppermost portion of the sacral spine to the right of the median line. There was some wasting of the muscles of the right thigh. His temperature on admission was 100.6° F., pulse, 96. The temperature has been as high as 104.8° F., with a pulse rate as high as 136. No blood examination was made at this time. At a later date an examination of his blood showed: hemoglobin, 75 per cent; color index, 0.72; red blood corpuscles, 5,200,000; white blood corpuscles, 29,900; small lymphocytes, 10 per cent; large lymphocytes, 4 per cent; mononuclears, 1 per cent; polymorphonuclears, 84 per cent; myelocytes, 1 per cent.

The swelling was incised February 22 and a considerable amount of purulent material was drained out. A roentgen examination made at this time (Fig. 2) showed the findings which usually go with Legg's disease, as demonstrated previously, but added to this there was observed an irregular area of lessened density very well defined which involved a small part of the upper half of the acetabulum. It seemed that we were dealing with a rarefaction in this region due to some form of osteomyelitis; being in the vicinity of a joint, particularly the hip joint, tuberculosis was suspected. Roentgenograms were also made at this time of the lumbar spine and pelvis but no evidence of the presence of a lesion could be observed in these areas. A smear made from the drainage of the sacral abscess showed the presence of an occasional acid fast bacillus resembling in its morphology the tubercle bacillus. Further roentgen examinations made at a later

FIG. 2. Roentgenogram made on February 19, 1924, showing a moderate degree of rarefaction of the right acetabulum.

date (Fig. 3) showed an extension of the process, but there was no evidence which would indicate involvement of either the spine or the sacrum. The extension of the process in the acetabulum is very marked so that a great part of the acetabulum is now affected by the involvement.

The fact that no lesion resembling that which is usually associated with an osteomyelitis was observed in the acetabulum at the time the first examination was made, which was on August 14, 1923, does not necessarily rule out its presence at that

time, since it is well recognized that osteomyelitis involving a bone or joint in its earliest stages may not manifest itself in a roentgenogram. We do know, however, that signs of Legg's disease were present. It is more than probable that the destructive process in the acetabulum began at the time the second illness started, which was in November, 1923. It is difficult to believe that an osteomyelitis could have been present from August to November

As we go back in the story of the illness as it started three months previous to February, 1924, we learn that the patient gives a history of having been thrown, striking his right side against the floor. The question naturally arises in one's mind as to what direct affect this had upon the development of the acetabular infection. Is it possible that the injury activated a latent tuberculous infection which may have been present in the hip joint? Since

FIG. 3. Roentgenogram made on March 24, 1924, showing an extension of the rarefied area within the acetabulum. (This illustration is reversed with relation to Figures 1 and 2).

without aggravating the clinical symptoms. What transpired between the first and second disturbances is merely conjectural. In the absence of specific pathologic diagnosis of Legg's disease, the roentgen findings are at present accepted as the final criterion for its diagnosis; on these grounds it would seem that the evidence is presumptive that the Legg's disease antedated the osteomyelitis and that the osteomyelitis which in this instance is most probably tuberculous in its origin need not be considered as an etiological factor in the causation of the disease.

almost all writers mention injury as a possible factor in the causation of Legg's disease it seems only fair to assume that up to this time more cases of tuberculosis developing in Legg's disease would have been reported.

Legg for instance, in 1916, presented 55 cases, 68 per cent of which gave a definite history of trauma. Zaaijer also calls attention to 55 cases reported in the literature in 1914, 66 per cent of which gave a definite history of injury. So that if we were to assume that the changes observed in the hip joint might possibly

be due to a latent tuberculous infection, then, with such a great percentage of cases giving a history of injury, we should have had more cases of tuberculosis of the hip joint reported. Since such is not the case, then it would seem that tuberculosis as an etiological factor in this condition can be very well ruled out. It is more than probable that the development of the osteomyelitis in this case, is merely coincidental. It is well to remember, therefore, that the presence of Legg's disease does not necessarily rule out the presence of a tuberculous process which may involve the same joint in which Legg's disease is present.

SUMMARY

A case of Legg's disease involving one hip joint having associated with it an osteomyelitis of the acetabulum is reported. Acid-fast bacilli were demonstrated in the smear so that the osteomyelitis is most probably tuberculous in its origin. The presumptive evidence at hand would lead one to believe that the presence of both conditions was merely coincidental and that tuberculosis as a factor in the etiology of Legg's disease need not be considered. It seems to be well established that Legg's disease and tuberculous osteomyelitis can occur in the same hip joint.

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TREATMENT OF FIBROMAS OF THE NASOPHARYNX: REPORT OF THIRTY-TWO CASES*

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THE type of treatment to be selected for new growths is that which will give the best end-results in each particular case. It is usually necessary to combine methods of treatment in order to obtain the best results; we believe, however, that certain of these methods are of major importance, and the others are of minor importance in the treatment of a given case.

Tumors of the nose, throat, and mouth may be classified in three groups for the employment of the major form of treatment: (1) tumors best suited to surgical procedures; (2) tumors best suited to cautery or diathermy; and (3) tumors best suited to treatment with roentgen and radium radiation. In Groups 1 and 2, radium or roentgen radiation is used in conjunction with the other methods. In our experience, fibromas of the nasopharynx should be placed in Group 3. Radium is the treatment of choice.

During the last fourteen years, 1910 to 1923 inclusive, we have examined at the Mayo Clinic 32 patients with fibromas of the nasopharynx. This group includes only the hard fibromas. The ages of the patients varied from ten to thirty-one years, the average being eighteen and one-half years. Twenty-nine (90.6 per cent) were less than twenty-five years of age at the time of examination, and three (9.3 per cent) were between twenty-seven and thirty-one years. The activity of the tumor seemed to be directly related to the age of the patient, although the fact that operations had been performed in many instances made it difficult to determine this point. Such tumors are more common in the male; there were 28 males and 4 females in our series.[1] The average age of the males was nineteen years, and that of the females, fifteen years.

The duration of symptoms previous to examination was from two months to six years. Five patients had had symptoms for less than one year, nine for more than two years.

PREVIOUS OPERATION AND TREATMENT

Twenty-three of the 32 patients in our series had been operated on from one to twelve times before their examination in the Clinic. The average number of operations was between three and four. Two patients said that they had had "multiple" operations; these operations were not included in the average. Five patients had not been treated previously. Treatment had consisted of internal medication, the application of caustics, fulguration, and roentgen radiation. Two patients had been treated with radium.

HISTORY, CLINICAL FINDINGS, AND DIAGNOSIS

Fibromas of the nasopharynx present a typical clinical picture; they have a definite life cycle, starting to grow about puberty, and continuing active until the age of about twenty-five years. The tumor is more amenable to treatment in older patients, since there seems to be a spontaneous retrogression after the age of twenty-three or twenty-five years. The tumor, which is hard, may be pedunculated or have a broad sessile base. It may have several attachments due to ulceration, and may fill the greater part of the nasopharynx. In 10 of our series the tumor was confined to the nasopharynx alone, and in 13 it had extended to both nostrils. The antrum was involved on one side in 2 cases, and the palate in 3. The tumor had apparently originated in the right side of the nasopharynx in 18 cases, in the left side in 9, in the median line in 3, and in one case the point of origin was not determined.

Fibromas of the nasopharynx are microscopically benign and clinically malignant.

[1] Alonso collected from literature thirteen cases of fibromas in the nasopharynx in women.

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This type of tumor does not metastasize, but may, owing to its location and extension into the skull, cause death. In some of the earlier cases, tissue was removed for microscopic examination; this proved to be fibroma, fibro-angioma, or fibromyxoma. In a few cases the specimen was reported inflammatory, due to the reaction from repeated previous operations and treatments. In the last four years no attempt was made to obtain tissue on account of the bleeding which accompanied such procedure, and the diagnosis was based on this history, the hardness of the tumor, the age of the patient, and the clinical picture.

TREATMENT

The surgical treatment of fibromas of the nasopharynx is usually attended with a high mortality and frequent recurrences, necessitating repeated operations. The severe hemorrhage which accompanies such operations makes them hazardous. Goldsmith recently reviewed the literature carefully and completely, and reported 2 cases. Wojatschek, in a recent contribution, reported 8 cases in which operation was performed by the transpalatal or transmaxillary route; although he had no immediate operative mortality, several patients had recurrences and one died subsequently of the disease. The condition of these patients was not observed for more than one year postoperatively. Kobylinski, in a series of 10 cases, reported 3 deaths due to hemorrhage. Dabney reported one case recently of a boy in whom the condition had almost entirely cleared up following one radium treatment. Crowe and Baylor reported 4 cases treated with radium. Two of their patients are well, and the others are improved. Alonso reported the case of a woman, aged forty-five years, who was well three years after operation and radium treatment.

The patients in our series, who were treated previous to our use of radium in these cases (1910–1915), were operated on by the avulsion method, both through the nose and the nasopharynx. During these years 8 patients were observed; 5 were operated on and 2 died; we were unable to trace the other 3 patients; 3 patients were examined only, and not treated.

From 1915 to January 1, 1924, twenty-four patients with fibromas of the nasopharynx were examined. Twenty-three were treated with radium. The treatment was applied by three methods. In the first or early cases, a T-shape lead applicator with a 50 mg. tube of radium in the trough of the T was held in various positions against the tumor in the nasopharynx. The original dose was usually a 50 mg. tube for from ten to fifteen hours. It was difficult to apply the radium accurately in this manner, and there was severe reaction in the structures around the tumor. In 2 cases the palate was perforated. Such complications are now prevented by protecting the posterior surface of the palate with a lead retractor made of 2 mm. of lead covered with a rubber finger cot, and by more accurate dosage.

In the second group of cases, steel points, containing the radium emanation or the element, were inserted directly into the tumor. Three or four points were usually inserted, depending on the size of the tumor, about the same amount of radium being used as in the initial dose.

In the third group of cases emanation seeds, averaging 0.5 to 1 millicurie each, were implanted directly into the tumor, the number depending on the size of the tumor. This method has been used in recent cases only. Such treatments are repeated in from six weeks to two or three months, depending on the reaction and the result of the previous treatment. The dosage of the secondary treatments varies greatly, depending on the progress of the case. The number of applications required, in the cases now cleared up, varied from two to nine, averaging between five and six. The length of time our patients were under treatment before the condition cleared entirely varied on account of the distance some of them lived from the Clinic, and the difficulty in returning; the average length of time was fourteen and two-tenths months. Several patients had been operated on elsewhere with much bleeding. The radium seems to have controlled this immediately. The crusting and scabbing secondary to radium treatment may be cared for symptomatically by the use of oil sprays, potassium iodid inter-

nally, and so forth. Table III demonstrates that treatment, and not the natural regression of the tumor, is the important factor in the cure of a patient. Eleven (73.3 per cent) of patients were less than twenty-three years of age when cured, and four (26.6 per cent) more than twenty-three years of age when cured.

SUMMARY

Radium is the treatment of choice for fibromas of the nasopharynx. With its use the usual operative mortality in these cases is eliminated. In most of our cases the tumor cleared up entirely, and in the others it was held in check during its period of activity.

TABLE I

END RESULTS

1910 to 1915	Patients treated before the use of radium	8
1915 to 1923	Patients treated after the use of radium	24
PATIENTS EXAMINED BEFORE THE USE OF RADIUM		8
	Patients operated on	5
	Operative deaths	2
	Not traced	3
	Patients examined only	3
PATIENTS EXAMINED AFTER THE USE OF RADIUM		24
	Patients cured	15
	Patients under treatment	4*
	Patients examined only	1
	Patients not traced	4†

* The 4 patients under treatment at the present time registered at the Clinic in 1923.

† The 4 patients, who were not traced, improved during treatment.

TABLE II

FIFTEEN PATIENTS CURED

Patients well from 7 to 8 years	2
Patients well from 6 to 7 years	0
Patients well from 5 to 6 years	2
Patients well from 4 to 5 years	1
Patients well from 3 to 4 years	3
Patients well from 2 to 3 years	3
Patients well from 1 to 2 years	4

TABLE III

AGE OF FIFTEEN PATIENTS WHEN CURED

11 (73.3 per cent)	13 years	1
	14 years	1
	15 years	2
	17 years	1
	18 years	1
	20 years	1
	21 years	2
	22 years	2
4 (26.6 per cent)	24 years	1
	27 years	1
	28 years	1
	32 years	1

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DISCUSSION

DR. GEORGE E. PFAHLER. I simply wish to add one case of this type which I have treated with success.

DR. R. E. LOUCKS, Detroit, Mich. I have treated one case of fibroma of the nasopharynx with success. The patient, treated four years ago, was unable to breathe through her nose and had lost some fifteen or eighteen pounds. The difficulty was, as Dr. Figi has pointed out, that the growth had to be treated through the pharynx first and by means of an applicator held against it until we had an opening. Then getting air and and an opening through one side of the nose we passed a string down, fastened it to our applicator covered with modeling compound, and held it in place. The patient had four treatments. The tumor did not recede entirely, but sufficiently to have a complete opening of both nares. She regained her original weight, improved generally, and when examined two years ago was well except for some remnants of the tumor in the nasopharynx.

DR. S. M. WITHERS, Denver, Colo. We have treated 4 cases of fibroma of the nasopharynx, 2 of which had been previously treated by men here, one at the Mayo Clinic and one by Dr. Pancoast. The other 2 cases I think were not seen by any of the members present. We have used bare tubes with emanation. The case treated by Dr. Pancoast three years ago is still under observation. The last time I saw him was six weeks ago, and there were still remnants of

the growth and occasionally bleeding. I do not believe we treated the case properly when it came into our hands, because of the fact that the boy was so emaciated from several hemorrhages that we did not feel justified in giving the dose of radium or roentgen rays demanded. I do not believe this case ever will be cured because there was a very large mass that had obliterated both antra and protruded through both nostrils. I have had correspondence with the University of Pennsylvania Hospital and they reported fibroma of the nasopharynx. We thought it was a fibrosarcoma.

Another case was treated by Dr. New at the Mayo Clinic and that patient has had no recurrence in three years. Since the man lives in Kansas he came to us instead of returning to the Mayo Clinic.

The other 2 cases we saw fairly early. One was immediately after supposed adenoids had been removed, and very little growth was evident. There has been no recurrence following the so-called prophylactic treatment. The other case has been doing well for two years. I wish to say that these cases tend to recur as long as four and five years after apparent regression.

THE TREATMENT OF DIPHTHERIA CARRIERS BY ROENTGEN RADIATION*

BY DALTON KAHN, M.D.

TOLEDO, OHIO

IN September, 1922, we presented a preliminary report of results obtained in the treatment by roentgen radiation of 185 refractory diphtheria carriers.[1] We desire at this time to report results of further study of those cases and to report 26 additional cases.

Our previous report showed that of 185 patients treated, we were able to obtain release from quarantine of 147 of the cases through negative cultural findings. The remaining 38 were released through negative virulence tests. No case required more than four treatments, in fact about two-thirds of the cases cleared up after a single treatment. The average number of treatments was 1.4.

Number of Treatments	Released on Virulence Tests	Released on Negative Cultures
4	1	1
3	3	2
2	16	39
1	18	105
	38	147

Ninety days after these patients were released we attempted to obtain recultures in order to study the permanency of the results obtained. We succeeded in locating and reculturing 152 of the original 185 cases. Of these 152 cases recultured, only 26 showed a positive morphological culture, but not a single one showed positive virulent diphtheria organisms, as determined by guinea pig virulence tests.

Of these 26 patients, 21 had been released, following one or more roentgen treatments, by negative guinea pig virulence tests, and only 5 were released by negative cultural findings.

Number of Treatments	Cases Treated	Cases Recultured	Cases Positive	Cases Virulent
4	2	1	1	0
3	5	4	1	0
2	55	43	4	0
1	123	104	20	0
	185	152	26	0
Released by Virulence Test	38	25	21	0
Released by Negative Culture	147	101	5	0

It is to be expected that persons released with morphologically positive, non-virulent diphtheria organisms in their throats and nasal passages, will continue to harbor such organisms for a considerable time. We believe that, had it been possible to continue treatment of all cases until their cultures were negative, our percentage of positive recultures would have been much lower.

Nine months after these cases were treated, Toledo experienced another epidemic of diphtheria and of this entire group of 185 cases, only one person developed diphtheria, and this was a carrier who

* Read at the Fifth Annual Meeting, Central Section American Roentgen Ray Society, Indianapolis, Ind., Feb. 23, 1924.

had received only one irradiation, being released on subsequent negative cultures.

In September, 1922, a second series of cases was treated by means of roentgen radiation. This series consisted of a group of 23 children, ranging in age from 5 to 15 years, who were pupils in a fresh air school. All of them were contact carriers, all had positive cultures at the time of first treatment, and all were released on three successive negative cultures, after one or two irradiations. Of the series of 23, 14 required only one treatment and 9 were given two treatments. These same patients passed through a subsequent epidemic of diphtheria about three months later, without developing a single case, and while we did not reculture, none of them was suspected of being a carrier in this later epidemic.

The patients of this second series were treated with a broad focus Coolidge tube, 10-in. focal skin distance, 7-in. spark gap, 5 ma., filtered through 3 mm. al, time, 4 min., with both tonsil areas and post-nasal space treated at each sitting. This technique is essentially the same as that used in our first series, except that the time of exposure has been lengthened to 4 minutes. The interval between successive treatments varied from 10 to 14 days.

Combining our first and second series of cases, together with 3 additional cases, reported below, we find that we have treated a total of 211 cases.

As an illustration of the effect of roentgen-ray treatment of diphtheria carriers we desire to present four case reports:

Case 1 (taken from our first series).

H. S., male, white, aged five. Developed active case of diphtheria, admitted to hospital, Nov. 29, 1921.

Case ran normal course and cleared so that release cultures were begun Dec. 9. During December, 9 cultures taken from nose and throat were positive for Klebs-Loeffler bacilli, from Jan. 2 to Jan. 16, four cultures were positive and three cultures were negative, no two negative cultures in succession. Jan. 16, 1922, roentgen treatment was given. Cultures Jan. 20, 23, and 25 were negative. Patient was given second roentgen treatment Jan. 25, and released.

Culture Reports

December 9, positive	January 2, positive
December 12, positive	January 4, negative
December 14, positive	January 6, positive
December 16, positive	January 9, negative
December 19, positive	January 11, positive
December 21, positive	January 13, negative
December 26, positive	January 16, positive
December 28, positive	January 18, positive
December 30, positive	January 20, negative
	January 23, negative
	January 25, negative.

During the period Dec. 9, 1921, to Jan. 16, 1922, prior to roentgen treatment the patient received vigorous treatment with local antiseptics, particularly argyrol and 5 per cent silver nitrate solution.

Case 11 (not reported in either first or second series).

P. W., female, white, aged thirty-three. Patient under arrest and serving workhouse sentence, admitted to Municipal Hospital for treatment for syphilis, with mucous patches and perforated septum, while in hospital she became a diphtheria contact. Jan. 29, 1923, culture and guinea pig virulence test were positive. Cultures from nose and throat persistently positive despite vigorous treatment with local antiseptics and hygeine. All local applications were discontinued on Mar. 28, when roentgen treatments were begun. April 6, cultures from nose and throat still positive and a second roentgen treatment was given.

Culture Reports

Jan. 29, positive (virulence pos.)	Mar. 2, positive
Feb. 1, negative	Mar. 5, positive
Feb. 3, positive	Mar. 7, positive
Feb. 5, negative	Mar. 9, positive
Feb. 7, positive	Mar. 12, positive
Feb. 11, positive	Mar. 14, positive
Feb. 12, positive	Mar. 16, positive
Feb. 14, positive	Mar. 19, positive
Feb. 16, negative	Mar. 21, positive
Feb. 19, positive	Mar. 23, positive
Feb. 21, positive	Mar. 26, positive
Feb. 23, negative	Mar. 28, positive
Feb. 26, positive	Mar. 30, positive
Feb. 28, positive	
Apr. 2, positive	
Apr. 6, positive	
Apr. 9, positive	
Apr. 11, nose positive throat negative	
Apr. 13, nose positive throat negative	
Apr. 27, nose positive throat negative	
Apr. 30, negative	
May 2, negative.	

April 11 and 13, nose cultures were positive and throat cultures were negative. She escaped from the hospital April 16, and was apprenhended April 27. At this time nose culture was still positive and throat culture negative. April 27, a third roentgen treatment was given over the nose. April 30, and May 2, nose and throat cultures were negative and patient returned to workhouse to complete sentence.

CASE III (not reported in either first or second series).

M. S., female, white, aged seven. Orphan, inmate St. A——Orphanage. Feb. 27, 1923, nose and throat cultures positive, and guinea pig virulence test positive, guinea pig dying in 48 hours. Virulence tests March 12, and 20, positive. March 28, first roentgen treatment was given, and all other treatment discontinued. April 6, cultures still positive and second roentgen treatment given. April 20, culture negative followed by positive culture April 24. Third roentgen treatment given April 27, at which time cultures were negative. Cultures continued, and were negative April 30, May 7, and 10, June 11, July 10, and 13.

Some interesting comments can be made on this case. During the year 1922, several outbreaks of diphtheria occurred in the orphanage of which this patient was an inmate, and at each outbreak she would show positive cultures. Treatment with local applications of argyrol would clear up her nose and throat and give negative cultures, after which she would be released from quarantine and be permitted to return to school with the other children. Soon after her return to the classroom, another outbreak of diphtheria would occur, and she would again have positive cultures and be quarantined, apparently responding quickly to treatment with local applications of argyrol, when she would again be released. According to the practice in the Orphanage this patient's tonsils and adenoids had been removed upon her admission to the institution three years previous, and as the operation appeared to be as complete as possible, it was supposed she was merely a contact carrier. However, after a virulence test on Feb. 27, 1923 it was felt she might be a chronic carrier, so she was isolated and subjected to vigorous treatment with local antiseptics, with the indifferent results recorded above.

Three irradiations rendered her cultures permanently negative. The last two cultures recorded in July were taken during a renewed outbreak of diphtheria in the Orphanage.

CULTURE REPORTS

Feb. 17, positive	April 4, positive
Feb. 23, negative	April 6, positive
Feb. 26, negative	April 9, positive
Feb. 27, positive (virulence pos.)	April 11, positive
	April 14, positive
Mar. 5, negative	April 17, positive
Mar. 7, positive	April 20, negative
Mar. 12, positive (virulence pos.)	April 24, positive
	April 27, negative
Mar. 15, positive	April 30, negative
Mar. 20, positive (virulence pos.)	May 7, negative
	May 10, negative
Mar. 28, positive	June 11, negative
Mar. 30, positive	July 10, negative
	July 13, negative.

CASE IV (not reported in first or second series).

B. L., male, white, aged seven. Quarantined as diphtheria carrier Oct. 29, 1923. Nasal discharge for several days before quarantine. Tonsils hypertrophied, left larger than right, crypts deep and ragged. Both throat and nose cultures positive for Klebs-Loeffler bacilli. Vigorous use of argyrol and silver nitrate solution did not influence carrier state. Guinea pig virulence tests positive upon six different occasions during October, November and December. Roentgen treatment given Dec. 11 over both tonsil areas, post-nasal space, and bridge of nose, all other treatment discontinued. Cultures Dec. 14 and 17 negative and patient released from quarantine.

CULTURE REPORT

Oct. 29, positive-virulent
Nov. 5, positive-virulent
Nov. 7, negative
Nov. 15, positive-virulent
Nov. 16, positive-virulent
Nov. 21, positive-virulent
Nov. 23, positive
Nov. 30, positive-virulent
Dec. 3, positive-virulent
Dec. 10, positive-virulent
Dec. 14, negative
Dec. 17, negative.

DISCUSSION

The treatment of diphtheria carriers by roentgen radiation was first suggested

by Witherbee[2] in January, 1921. Later Hickey[3] reported treating a number of cases by this method and obtaining a cure in 80 per cent. During discussion of Dr. Hickey's paper, Dr. Ledoux-Lebard reported having treated about 10 cases in the army during the recent war. We have been unable to find any further reports in the literature concerning the treatment of diphtheria carriers by means of roentgen radiation.

Hitherto we have had recourse to two methods for the treatment of diphtheria carriers; namely, treatment with local antiseptics, and tonsillectomy. The use of roentgen radiation offers a third method, and one which we believe promises to be the most efficacious.

Treatment by local application of antiseptic solutions has been used for a long time, and many antiseptic reagents have been recommended. Of these, mercurochrome solutions have probably given the best results with as high as 60 per cent cures reported.[3]

Tonsillectomy has been the method of choice, and the only method which was capable of giving 80 per cent cures. However tonsillectomy has certain inherent drawbacks to its adoption as a universal procedure, or as a public health preventive measure. Among these objections we find the difficulty of obtaining the patient's or parents' consent to so drastic a measure; secondly, there is always the danger from anesthesia and possible hemorrhage, and finally and most important, the fact that in many diphtheria carriers, the site of infection is not in the tonsil at all, but in the nasal and post-nasal passages.

It has been well established that the injection of antitoxin in no way influences the development or cure of the carrier state.

In addition to the fact that treatment by roentgen radiation offers the possibilities of 100 per cent cure, the method has other advantages to recommend it for general use, especially in times of epidemics. It is absolutely painless, it requires no anesthetic, it takes the minimum amount of the patient's time and affords him the maximum amount of comfort, and finally there is not the slightest possibility of danger to the patient in any way, provided, of course, that the treatments are given by a competent roentgen therapist.

It has been found, that while 2½ skin units of filtered radiation is the standard erythema dose, as established by Witherbee and Remer,[4] at times as low as 2 skin units will produce an erythema in the sensitive parts of the bodies of young subjects.[5]

It will be seen that with the technique described (5 ma. at 10-in. focal skin distance, with 7-in. spark gap, filtered through 3 mm. al.) it will require a 13-min. and 12-sec. exposure to administer 2 skin units. We have never found it necessary to use more than a 4-min. exposure, which gives a dosage of a fraction more than one skin unit, allowing a large margin of safety over the 2 skin unit minimum required to produce an erythema. The time of exposure can be doubled or even trebled without crossing the danger threshold.

We do not claim any bactericidal effects for roentgen rays, but believe the results obtained are due to the fact that the tissues of the throat and nasopharynx are altered to such a degree, that instead of being a suitable soil for the propagation of bacteria, it becomes decidedly unsuitable.

SUMMARY

Data are presented which show that 152 of our original 185 cases of carriers treated by roentgen radiation have tended to remain free from virulent diphtheria organisms, as determined by reculture, after an interval of ninety days.

A second series of 23 cases is presented in all of which we were able to obtain negative cultures after one or at most two roentgen treatments (these treatments were slightly longer in time of exposure than formerly).

Complete histories are given of 3 additional cases that were true carriers, which cleared up after roentgen treatment, other measures having failed.

The technique now recommended for treating diphtheria carriers is described.

The advantages of irradiation over treatment by tonsillectomy, or by antiseptics are pointed out.

We desire to express appreciation to Dr. D. W. Iford, present Commissioner of Health of the City of Toledo, and to many members of the staff of that Department, who by their aid and cooperation have made this study possible.

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THE TREATMENT OF MALIGNANT DISEASES IN THE MOUTH*

BY G. W. GRIER, M.D., F.A.C.P.

PITTSBURGH, PENNSYLVANIA

THE radiotherapy of malignant lesions of the mouth consists of two distinct procedures, treatment of the primary lesion and treatment of or an attempt to prevent metastases. Since the latter is an indispensable part of the treatment and is carried out in essentially the same manner, whatever the location or extent of the primary lesion, I shall speak of it first.

It is true that the presence of extensive cervical metastases at the time the patient presents himself may call for more intensive treatment, but in all cases sufficient treatment should be given to destroy malignancy whether it is demonstrable or not. It is only in this manner that the chances for permanent recovery may be improved. If the neck is not treated until metastases are palpable, the case becomes a serious one and the possibility of a complete cure doubtful. Surgical opinion regarding dissection of the neck for palpable metastases is evidently in a transitional period. Thus Pinch[1] states that the sublingual, submaxillary and all enlarged lymphatic glands on one or both sides should be removed; Quick[2] uses external radiation followed by dissection if the case is early, or by implantation of emanation seeds into the malignant masses if after exploration they are found to have broken through the capsule of the gland. In far advanced cases he uses external radiation only, or implants radium emanation seeds through the skin. Hanford[3] believes that where palpable glands exist, they should be removed surgically and radium placed in the field of operation.

My own experience is much less extensive than that of any of the authors quoted and my opinions are probably biased by the fact that I am a radiotherapist and not a surgeon. My results with cervical metastases are about as follows:

1. Roentgen-ray treatment with 9-in. back-up is only effective for prophylaxis (where, of course, there may be no metastases, or where the glands are extremely small).

2. Radium treatment externally has given no different results from roentgen radiation with 9-in. back-up.

3. Radium needles buried in large cervical masses through the skin have not produced any cures in my hands.

4. Removal of large masses and burial of radium in the wound has also been ineffective, possibly because, as Quick says, the malignancy had broken through the capsule and removal should not have been attempted.

5. Recurrences after surgical removal have, as a rule, been entirely unaffected by any radiation I have been able to apply. I believe there are two reasons for this: (*a*) Surgery, if ineffective, has a tendency to aggravate malignancy. (*b*) All patients naturally look upon surgery as a final and complete treatment and are,

* Read at the Ninth Annual Meeting, AMERICAN RADIUM SOCIETY, Chicago, Ill., June 9–10, 1924.

therefore, not apt to apply for radiation until recurrence has taken place. Even if postoperative prophylactic treatment is given, the radiotherapist may unconsciously lean toward this viewpoint which is more or less universal, and treat less vigorously than he would if no operation had been done.

6. High voltage roentgen therapy has given somewhat better results than any of the foregoing methods, at least in so far as the disappearance of palpable manifestations of disease are concerned. Not all cases respond alike to this treatment and some are practically unaffected. It may be that these which are now better, or apparently free from disease, may relapse later. There has not been time enough yet to tell this, but the effect so far is better than I have been able to get by other methods.

Whatever treatment may be selected for advanced cervical metastases, it is undoubtedly true that this is a grave and frequently fatal complication and anything which can be done to lessen the likelihood of its occurrence is most urgently indicated. For this reason, I always begin the treatment of any intra-oral malignancy by intensive radiation of the neck. I am now using for this purpose the so-called deep therapy technique, applying an

INCIDENCE OF CERVICAL METASTASES

	Total Cases Treated	Total Cures	Cures with Glands	Total Deaths	Deaths with Glands	Improved	Unimproved	Stopped Treatment	Total with Glands
Epithelioma, upper lip	8	8	0	0	0	..	..	..	0
Epithelioma, lower lip	48	38	6	6	6	..	1	1	14
Leucoplakia, lower lip	11	11	0	0	0	..	..	..	0
Epithelioma, buccal mucosa	16	7	0	8	7	..	..	..	7
Epithelioma, alveolar process	8	4	0	3	3	1	..	..	4
Epithelioma floor mouth	4	1	0	3	3	..	..	..	3
Roof of mouth carcinoma	1	..	0	1	1	..	..	..	1
Roof of mouth sarcoma	6	1	0	4	0	..	..	..	0
Carcinoma, tongue	15	2	0	13	13	..	..	..	13
Questionable diagnosis	5	5	0	0	0	..	..	..	0
Carcinoma, tonsillar region	9	3 (1 yr.)	2	6	6	..	..	..	8
	131	80	8	44	39	1	1	1	50

MALIGNANCY OF MOUTH

	Apparently Cured	Dead	Unimproved	Improved—Still under Treatment	Stopped Treatment	Total
Epithelioma, upper lip	8	..	..	..	..	8
Epithelioma, lower lip	38	6	1	..	3	48
Leucoplakia, lower lip	11	..	..	..	..	11
Epithelioma, buccal membrane	7	8	..	1	..	16
Epithelioma, alveolar process	4	3	..	1	..	8
Epithelioma, floor mouth	1	3	..	..	..	4
Roof of mouth carcinoma	..	1	..	..	..	1
Roof of mouth sarcoma	1	4	..	1	..	6
Carcinoma, tongue	2	13	..	..	..	15
Questionable diagnosis	5	..	..	..	..	5
Carcinoma, tonsillar region	3 (1 yr.)	6	..	..	..	9
	80	40	1	3	3	131

erythema dose at one sitting before the primary lesion is touched. With our apparatus the factors used are 200 kv., 4½ ma., 20-in. skin focal distance, 0.5 mm. cu and 1 mm. Al filter, applied over an area 10 cm. square for 90 min. If both sides of the neck are treated, the dose is modified so that the skin on each side receives only an erythema dose. If there are palpable masses I repeat this dose in 6 weeks, or as much sooner as the condition of the skin will permit, and as often thereafter as possible until the glands disappear. If there are no enlarged glands when first seen, I repeat the dose in 8 weeks. Where individual preference favors surgical removal, it may be done following this preliminary radiation, but I believe this radiation is indispensable and that it should be continued after operation in the same manner as if no operation had been done.

The treatment of the primary lesion varies somewhat depending upon its location. In epithelioma of the lip, I prefer roentgen radiation to radium, principally because it is more easily applied, and also because my results have been so uniformly good with roentgen radiation that I do not care to change. Of the 48 cases of epithelioma of the lower lip reported in this paper, 42 were treated with roentgen radiation and of this number, 40 were cured of the primary lesion and 2 stopped treatment. From these results I feel reasonably confident of destroying the lesion on the lip if the patient applies for treatment before the lesion is hopelessly advanced and if he has not already been improperly treated. Incomplete operation with recurrence or prolonged but inadequate radiation is the cause of most failures. I have been disappointed in the use of radium needles introduced into the lip. In the few cases which I have treated in this manner, most extensive sloughing has resulted, with the destruction of a large part of the lip, but without curing the malignancy. It is evidently the combination of infection and malignancy which is so disastrous in these cases. Since the mouth is always infected, it is practically impossible to introduce radium needles into the tissues there without also introducing infection. The necrosis which always follows in the tissues adjacent to the needle promotes the infection and if the dosage is excessive, the resultant sloughing adds to the unfavorable effect. For this reason, I never use radium needles in the mouth if it is possible to treat the lesion successfully by a surface application. If it is necessary to introduce needles, as in the tonsillar region or the tongue, they should not be left in too long. I believe from 7 to 9 hours is the limit that 12.5 mg. needles should be left imbedded where they are placed 1 cm. apart.

I can see no reason for running the risk of these untoward effects in cancer of the lip in the vast majority of cases. These patients usually apply early for treatment because the lesion is in a conspicuous place and if seen early when the involvement is superficial, the surface application of roentgen rays, or radium if preferred will destroy the lesion. When so treated the initial dosage should be large enough to completely eradicate the disease. Prolonged radiation with ineffectual dosage raises the resistance of the growth to radiation, so that subsequent treatment has no effect. I have described the roentgen-ray technique which I use in cancer of the lip in a previous article.[4]

Lesions situated entirely within the mouth are too inaccessible to roentgen-rays to be properly treated. Radium is indispensable in these cases, and up to a certain stage in the progress of the disease usually produces satisfactory and sometimes remarkable results. After the lesion reaches a certain stage, it seems that no treatment does any good and the patient rapidly grows worse. If the patient is seen before this stage there is always a fair chance for recovery (in the absence of metastases), provided the treatment is properly carried out. Technique probably plays a more important part in mouth lesions than in any other location. If the lesion is underdosed, it has progressed to an incurable stage by the time the dose is repeated. Repeated small doses are known to render the disease insensible to further radiation, even if massive doses are resorted to. On the other hand, over-dosage, at least

by the method of introducing needles, causes extensive sloughing and the patient often dies with the lesion still in that state. Whether there is any malignant tissue left after such treatment, or whether the patient dies from the result of the infected slough, I am not able to say.

Where a contact application is made there is more likelihood of under dosage, especially if only a small quantity of radium is available, and if an attempt is made to have the patient hold the radium against the lesion. Our earlier cases were

FIG. 1.

treated in this way, using 50 mg. of radium with little filtration and applied for an hour or two at a time. The results by this method were very poor. I believe it is necessary to use sufficient filtration to cut out most of the beta rays, or else the lesion will be under-dosed at its depths. I now use 1 mm. brass filter and 2 mm. of rubber and leave in position for 12 to 15 hours. It is obviously impossible for a patient to hold the radium in position for this length of time, and for this purpose I cut applicators out of sheet lead of such a size and bent in such a manner that they will hold the radium in position when brought out of the mouth and bent over the cheek or chin and fastened with adhesive plaster and bandages (Fig. 1). A new applicator must be made to fit each case, of course, as no two lesions are ever alike in location and extent. By a small amount of ingenuity these can be fashioned to hold the radium accurately in position as long as desired. If the lesion is tender some narcotic may be necessary to make the treatment bearable. Liquids may be taken through a tube while the radium is in position. The applicators can be used successfully in lesions located in the floor of the mouth, roof of the mouth, on the alveolar process anywhere, and on the buccal mucous membrane. Where the lesion covers a large surface I use 25 mg. tubes placed side by side, sufficient in number to cover the whole area, or if small, one 50 mg. tube. I have not used 50 mg. tubes side by side. An effort is made to protect normal tissues as far as possible by bending the lead to cover areas which it is unnecessary to treat. A surface burn follows this treatment but invariably heals in from 4 to 6 weeks. If the radium is close to bone it is not wise to treat longer than 12 hours. This dose is a destructive one and in my experience if it is not effective the case is not curable by radiation, always supposing, of course, that the radium has been placed so as to cover all of the lesion. If by chance there happens to be an untreated edge beyond the range of the radium which persists after the remainder of the lesion is healed, this may be treated by a second application. The aim is, however, to completely destroy the lesion with one treatment because by so doing the patient's chances for complete recovery are very greatly increased. I have found this technique much more effective than repeated small doses using but little filtration.

In cancer of the tongue I use needles containing radium element imbedded in and around the lesion, placed about 1 cm. apart and left in position for 7 to 9 hours. If the lesion is far advanced with deep ulceration, the treatment will probably not be successful. If the patient is also syphilitic, the prognosis is particularly bad. If the case is seen quite early there is a reasonable chance of destroying the lesion, but probably no better than by surgery at the same period. It is true that the only 2 cases which we have cured for a longer period than 5 years had a partial amputation first before the radium was applied. However, these 2 cases were very early,

with no metastases, and the diagnosis was not verified by section, so they should really come in the same category with the 5 cases of questionable diagnosis treated since by radiation alone and also well at this date. We have also since treated 2 cases of proven carcinoma of the tongue of moderate involvement in which the primary lesion healed and remained so, but the patients died of metastases. My experience in cancer of the tongue might be summed up as follows:

1. The cervical region should be radiated thoroughly before any treatment of the primary lesion is attempted.

2. If the lesion is early there is a fair chance of destroying it by the implantation of radium needles. Some of these early lesions may be of questionable diagnosis, but if allowed to go untreated until they are cancerous beyond any doubt, it may be too late to cure the patient.

3. Far advanced cases offer little hope of recovery and no objection should be made to amputation if the surgeon considers it advisable.

4. The combination of cancer of the tongue and syphilis is particularly bad.

5. Under-dosage is useless and possibly keeps the patient from obtaining other treatment during a period when the lesion may be curable. Over-dosage causes violent sloughing which gives the patient great pain, it increases the danger of hemorrhage and lessens the chances of recovery. Not less than 7, nor more than 9 hours is the proper dosage with 12.5 mg. needles placed 1 cm. apart.

6. Roentgen radiation in cancer of the tongue has had no beneficial effect.

In cancer of the tonsillar region there is a good chance of destroying the primary lesion unless the involvement is very extensive. Radium needles should be imbedded into and around the lesion and left 7 to 9 hours. I prefer to introduce the needles antero-posteriorly when possible. Care should be taken not to get them too close to the jaw bone. If the lesion has spread into the tonsillar region from the molar region, the alveolar process may be involved, which makes a serious complication. Lesions of the alveolar process are better treated by a contact application than by needles. If both the molar region and the tonsillar region are involved, it is better to treat by a combination of contact over the alveolar process and the introduction of needles into the tonsillar region. As in cancer of the tongue, the cervical region should have a full dose of radiation before the primary lesion is treated.

CONCLUSIONS

1. The majority of patients with malignancy of the mouth die of metastases. Therefore, the treatment of these metastases is an absolutely essential part of any plan of treatment.

2. The primary lesion must be treated thoroughly and accurately with a definite idea of what the treatment will accomplish.

FAILURES

	Lip	Buccal Membrane	Alveolar Process	Floor of Mouth	Roof of Mouth	Tongue	Tonsil	Total
Improper radiation	3	2	..	1	..	2	1	9
Involvement too extensive when treatment was instituted	..	..	..	..	..	7	2	9
Metastases	2	1	..	..	2	4	3	12
Refractory patient—neglected treatment	3	..	..	1	..	..	..	4
Hemorrhage	..	..	..	1	..	..	..	1
Involvement of bone	..	..	1	..	4	..	..	5
Not influenced by radiation	..	1	..	..	..	..	..	1
Sinuses to skin surface when treatment was instituted	..	3	..	..	..	..	..	3
Recurrence after operation not influenced by radiation	2	1	2	..	..	..	..	5
Total	10	8	3	3	6	13	6	49

A temporizing method of treating and observing results and repeating this indefinitely is not permissible.

3. Lesions on the alveolar processes, buccal mucous membrane, roof of the mouth and floor of the mouth are better treated by contact application than by imbedding needles.

4. Over-dosage with imbedded needles causes extensive sloughing which does more harm than good.

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ABSTRACT OF DISCUSSION

Dr. Howard Morrow, San Francisco, Calif. In the treatment of malignant disease of the mouth we are confined to surgery, electrodesiccation and radium. Each has its advantages and disadvantages. We have used radium in the form of bare tubes. During the past two years we have used weaker tubes than formerly, and I believe the results have been better and there has been less pain and ulceration. We have reduced the strength of our tubes from 1.0 mc. or more to 0.5 to 0.75 mc. Almost any *early* cancer of the mouth can be healed by electrodesiccation or radium. Our great trouble has been with metastases, for which all methods of therapy have seemed unsatisfactory. The method suggested by Dr. Grier should be encouraged.

I should like to go on record as favoring a biopsy in as many cases of mouth malignancy as possible.

Professor C. L. Regaud, Paris, France. One can avoid necrosis by using the emanation in needles made of platinum instead of steel and 0.5 mm. thick. Instead of using single large doses in the mouth or tongue I use small amounts of radium in the needles and leave them in several days, burying only two or three of the applicators, going through only the superficial part of the tongue.

Dr. George E. Pfahler, Philadelphia. I would suggest in connection with Dr. Grier's technique that vulcanized rubber be used instead of adhesive plaster over the applicators.

INTRAPERITONEAL INSERTION OF BURIED CAPILLARY GLASS TUBES OF RADIUM EMANATION IN CARCINOMA OF THE CERVIX UTERI*

BY ISAAC LEVIN, M.D.

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RADIUM and roentgen therapy is beginning to acquire such a preeminent position in the treatment of carcinoma of the cervix uteri that recently surgeons themselves are beginning to abandon radical panhysterectomies in favor of irradiation. Ochsner[1] states that during the last four years he has turned over to treatment with radium and roentgen radiation all cases of carcinoma of the cervix, even those not advanced.

A brief perusal of some clinical reports will clearly indicate the reason for the superiority of radiotherapy in these cases. Peterson[2] reports that 40.9 per cent of all the patients operated upon for cancer of the cervix were cured. However, he operated upon only 60 out of the 380 patients with carcinoma of the cervix who came to him for treatment. Thus, in reality, 18 patients, or 4.7 per cent of the whole number of his patients were cured. At the same time 14 out of the 60 patients operated upon died as the immediate result of the operation.

Burnam[3] reports on 700 cases of uterine, cervical and vaginal carcinomas treated with radium. Of the cases of carcinoma of the cervix irradiation alone cured 50 per cent of the operable cases, 31 per cent of the borderline cases, 9 per cent of the inoperable cases, and 11 per cent of the recurrent inoperable cases.

If one compares these two reports, the striking difference is most apparent, not so much in the very early operable cases,

* Read at the Ninth Annual Meeting, American Radium Society, Chicago, Ill., June 9–10, 1924.

which give fairly satisfactory results by either method, but in the inoperable advanced cases, and these latter represent at least 80 per cent of all the cases met in practice. For these hopeless cases surgery offers nothing, and the moment the surgeon becomes more liberal in his interpretation of operability his percentage of cure becomes lower and the percentage of postoperative mortality higher. Moreover, radical surgery in cancer has reached the limit of its perfection, and as Finney stated in 1910, in discussing the paper on "The Cure of Cancer and Cancer Cures" presented by A. D. Bevan before the meeting of the American Surgical Association, "We cannot make much wider dissection than we are doing now."

It seems that further progress therefore in the treatment of carcinoma of the cervix must come from improvement in the methods of radiotherapy.

Analysis of the more recent reports of the results of radiotherapy in carcinoma of the cervix shows a fair similarity in the statistical figures published by the different clinicians. Burnam, as stated above, reports 31 per cent of borderline cases cured, 9 per cent of inoperable cases, and 11 per cent of recurrent cases. A computation of his figures tends to show that approximately 20 per cent of all his inoperable cases were cured. Clark and Keene[4] report on 412 cases of carcinoma of the pelvic organs and state that of the inoperable cases 19 per cent plus are well five years after treatment. Schmitz[5] of Chicago gives a most comprehensive report of 423 cases, of which 303 were cervical cancers. He classifies his cases in five groups and gives a very clear definition of each group.

(1) *Localized,* in which the carcinoma is confined to the uterus.

(2) *Borderline,* in which it is doubtful whether the carcinoma is still confined to the uterus or has begun to invade the neighboring tissues.

(3) *Inoperable,* in which an invasion of the neighboring tissues or organs or the regional lymph nodes can be demonstrated.

(4) *Advanced,* which is characterized by a "frozen pelvis," cachexia and distant metastases.

(5) *Complicated,* in which the cancer may be limited to the uterus, but there are present grave constitutional diseases.

Of the 303 cases which he had under treatment 77 are alive, giving an average of 25.4 per cent cured. His borderline cases showed over 50 per cent cured and of the purely inoperable cases 17.6 per cent are cured.

It is extremely difficult to compare reports from two clinics, since the classification of the cases depends to a great extent on the personal equation of the examining clinician. Nevertheless, the impression gained by a comparative analysis is that the results obtained by Schmitz are somewhat superior to those obtained by Burnam or Clark and Keene. These superior results may be due to the fact that the patients of the latter clinicians have received only radium therapy while the patients of Schmitz received the combination of radium and high voltage roentgen therapy.

However, as stated above, there is to date comparatively little difference between the results obtained by different clinicians by the aid of radium and roentgen therapy in carcinoma of the cervix. In inoperable cases, as stated above, even Schmitz obtained only 17.6 per cent of clinical cures.

The methods which the writer has employed in the treatment of carcinoma of the cervix have changed from time to time. They consisted at first in intravaginal and intracervical application of filtered radium combined with roentgen therapy of the pelvic region. At present the method of radiotherapy in these cases consists in the intratumoral insertion of buried capillaries of radium emanation accompanied by high voltage roentgen therapy of the pelvis.

During the last five years the writer[6] has done a considerable amount of experimental and clinical investigation of this method of intratumoral insertion of glass capillaries of radium emanation. The method will play a prominent part in the future development of radiotherapeutics in cancer and it will therefore not be amiss to state here briefly the writer's conception of the mechanism of the biological action of these capillaries of radium emanation. Unlike the metal

filtered radium the thin glass wall of the capillaries filters off only the alpha rays and allows the free passage of both the beta and gamma rays. Consequently the main difference between the action of the glass capillaries of radium emanation and the filtered radium, whether used as a flat applicator or a metal needle, consists in the fact that in the latter only the gamma rays are used, while in the former the beta rays are also employed.

It is difficult to separate the beta rays from the gamma rays in order to study the biological action of the former, though Abbe recently made an attempt in this direction. However, the biological and therapeutic results obtained by the action of gamma rays alone and by the combined action of beta and gamma rays differ to such an extent that certain conclusions as to the action of the beta rays can be drawn.

In cooperation with Michael Levine, the writer[7] employed this method experimentally on normal and neoplastic tissues of animals and plants. The capillary glass tubes were inserted into normal liver, spleen and bone marrow of rabbits, into muscles and testicles of rats and mice, into sarcoma of rats, carcinoma of mice, into normal young plant tissue, into crown galls of geranium and into club roots of cabbage.

A gross and microscopic analysis of the irradiated tissues was made. The zone of tissue immediately surrounding the glass capillary was in a state of complete necrosis. The second zone showed characteristic gamma ray irradiation changes in the protoplasm and nuclei of the cells. This latter zone was more extensive in tumor than in normal tissues.

In addition to the experimental investigations, the writer subjected to microscopic study tissues obtained on clinical material at various intervals after the insertion of the glass capillaries. In general, the clinical results are very significant. Pathological conditions, which do not yield to large quantities of filtered rays, respond readily to the beta ray action.

Microscopically, human tissues examined one to two weeks after the insertion of the capillaries show the same condition as in animal and plant tissues, i.e., a narrow zone of necrotic tissue and a second larger zone which shows the effect of gamma radiation. In material studied six to eight weeks after the insertion of the capillaries the necrotic tissue is found to be completely absorbed and the second zone of tissue is replaced by connective tissue. The ultimate clinical result is replacement of all or most of the cancer tissue by dense connective tissue scarring. Progressive necrotization and sloughing takes place when too large a dose has been used, and particularly in ulcerating tumors.

A superficial analysis of the results obtained may produce the impression that the action of the beta rays on the first zone of tissue is identical with the action of a simple caustic agent. A closer study of the phenomena involved, however, shows that the mechanism of the action of beta rays differs widely from the caustic effects of heat or chemical agents and is qualitatively analogous to the action of the gamma rays. Moreover, the whole sequence of the tissue changes reported above may result from the action of large amounts of gamma rays.

The biological action of the gamma rays of radium and of the analogous roentgen rays must depend in the ultimate analysis of the intra-atomic action of these rays on the atoms of elements. This action, in accordance with the present day conception of physics, is as follows.

Gamma rays and roentgen rays are rays of light of very small wave lengths. When they enter an atom of matter they disturb the electronic equilibrium and free a certain number of electrons of the influence of the positive nucleus of the atom. These free electrons travel in a certain direction with a given velocity and as a result produce within the ether scattered or characteristic roentgen rays. The results will be the same whether the original agents are the gamma rays or the roentgen rays.

A biological effect of the rays on tissues means a change in the structure of the tissues and must be a result of changes in the atoms of the tissues. A gamma ray entering the tissues sets into motion a number of electrons. The latter produce secondary roentgen rays which influence the other component parts of the tissue.

Beta rays are themselves electrons in motion and when they enter the tissue they must produce analogous secondary roentgen rays, because they have a velocity similar to the velocity of the electrons produced in the tissue by the gamma rays of radium. Consequently biological action of the gamma and beta rays must be analogous. The difference is quantitative and is due to the fact that the ratio of beta and gamma rays in a unit of radium is about 100 to 1. Five millicuries of radium emanation distributed in 10 capillaries will destroy 10 cu. mm. of carcinoma. To produce the same effect by surface application, the gamma rays of 500 millicuries would have to be employed. The statement made by physicists that the biological effect of 1 millicurie of radium emanation buried in the tissues equals 132 millicurie hours of surface application of filtered radium takes into account only the action of the gamma rays and disregards the action of the beta rays and their secondary *x*-rays.

The outstanding fact in the whole field of therapy, by surgery or radiation, of cervical cancer is that the results become poorer the more the process advances into the broad ligaments, the other pelvic structures and regional lymph nodes. That surgical removal must fail in all of these cases is self evident, since dissection must be done within an area infected with cancer cells and serves only to disseminate these cells through the opened lymph and blood channels. The failure of the present methods of radiotherapy, on the other hand, must be due to the fact that the radiations do not reach with the necessary intensity into all the distant areas involved in the process. That radium in any form introduced through the vagina cannot influence a carcinoma high up in the pelvis unless the quantities are so large that normal vital organs are injured is an established fact. Large quantities of radium, placed over the abdomen in combination with vaginal irradiation, may influence a certain number of cases. For a time it was hoped that by the aid of the high voltage roentgen-ray apparatus and tubes much better results would be obtained. But even with all these methods combined not more than 20 per cent of the clearly inoperable cases with involvement of the broad ligaments and the regional lymph nodes can be influenced. It is thus self evident that a constant search for any additional method of radiotherapy is more than justified.

For the last four years the writer[6] has done a considerable amount of clinical work with the intratumoral insertion of buried capillary glass tubes of radium emanation introduced through a laparotomy wound. For instance, when a carcinoma of the recto-sigmoid juncture is situated so high that the upper margin cannot be reached through the anus, a laparotomy is performed. The patient is placed in a steep Trendelenburg position and if a radical surgical removal of the tumor cannot be done then the radium emanation capillaries are introduced through the peritoneal covering into the tumor mass of the rectum or sigmoid. If necessary, a colostomy is done at the same sitting. The capillaries used for intraperitoneal insertion are sterilized either by boiling or by immersion in alcohol iodine and must contain not more than between 0.2 to 0.7 mc. of radium emanation. Following the intraperitoneal insertion of the capillaries, there may take place a severe reaction with high temperature which subsides in a few days. This reaction, in the experience of the writer, takes place only in those cases in which the tumor is ulcerated, like carcinoma of the rectum or cervix, and is most probably due to the combination of bacterial infection and radium necrotization. The writer employed the method of intraperitoneal insertion in tumors of the ovaries, retroperitoneal tumors and hypernephroma and saw no reaction following the insertion. On the other hand a severe reaction, as will be shown later, may follow insertion into the tumor of the cervix through the vagina without a laparotomy. In the majority of cases there is no reaction and the patients make an uneventful recovery.

The present report is based mainly on the work done in cooperation with Dr. Gustav Seeligmann at his Gynecological Service of the Lenox Hill Hospital, New York. For the last two and a half years Dr. Seeligmann and the writer have treated

all cases of carcinoma of the cervix either by radiotherapy alone or by combination of radiotherapy and surgery. Different methods were tested and finally the following general scheme was followed. A thorough examination of the patient is made and if it is determined that the carcinoma is confined to the cervix and the vaginal wall then radium emanation capillaries are inserted through the vagina, and this is followed by a course of high voltage roentgen therapy. In cases in which the broad ligaments are involved and there are fixed pelvic masses palpated, a laparotomy is performed. The patient is placed in a Trendelenburg position and the capillaries are inserted into carcinomatous tissue wherever it is found, i.e., the broad ligaments, the spaces between bladder and uterus, between uterus and rectum, into the regional lymph nodes and also into the supravaginal portion of the cervix. The operation, as stated above, is in some cases followed by a severe reaction with high fever which generally subsides in a few days. In other cases no reaction follows the intraperitoneal insertion of the capillaries and the patients make an uneventful recovery. The presence or absence of reaction does not depend upon the extent of the growth or the amount of radium emanation used and, as stated above, is due to a combination of bacterial infection and radium reaction. After the patients have recovered completely from the effects of the operation, they receive a course of high voltage roentgen therapy.

The two following cases selected from the series used for this investigation will serve to illustrate the various points mentioned in connection with this method of radium therapy in carcinoma of the cervix.

Case 1. C. L., aged forty-two, entered Lenox Hill Hospital on the service of Dr. G. Seeligmann in May, 1923, with advanced inoperable carcinoma of the cervix with involvement of right broad ligament. A laparotomy was done on May 11, 1923. Radium emanation capillaries were inserted into the anterior and posterior surfaces of the right broad ligament and into the posterior surface of the supravaginal portion of the cervix. Fifteen capillaries were inserted with a total amount of 6.4 mc. On May 18, twenty capillaries with a total amount of 8.5 mc. were inserted into the cervix through the vagina. There was no reaction and the patient made an uneventful recovery. In December, 1923, seven months later, Dr. A. Stein did a complete hysterectomy which offered no unusual difficulties. At present the patient is clinically well.

Case 11. C. S., aged forty-seven, entered the Lenox Hill Hospital on the service of Dr. G. Seeligmann on February 5, 1924, with chief complaint of vaginal bleeding, foul vaginal discharge and loss of strength. Examination showed that the cervix was replaced by a large cauliflower mass which involved the fornices and the upper fourth of the vaginal wall. On February 8, an operation was performed which consisted in cauterization of the cervix and laparotomy. Radium emanation capillaries were inserted into the posterior wall of the supravaginal portion of the cervix and into the left broad ligament. The capillaries introduced into the anterior and posterior walls of the cervix are close to the surface and act on the spaces between the rectum and the uterus and the bladder and the uterus. In all, 18 capillaries with a total amount of 8.4 mc. of radium emanation were inserted. The wound healed by primary union and there was no reaction. On February 29, i.e., three weeks after the laparotomy, 19 capillaries with a total amount of 6.1 mc. of radium were inserted into the cervix through the vagina. Four days later the patient began a severe reaction with the temperature as high as 106.6. This lasted for ten days. On March 13 the patient was discharged from the hospital and at present she is in good condition.

The analysis of the cases shows that patients recover from the operation even when there is a severe reaction following the operation. And what is still more significant after an intraperitoneal insertion of radium emanation capillaries a panhysterectomy may be performed with ease, and the patient remains well after both operations. It must be stated here, however, that as a general rule the writer is not in favor of hysterectomy after irradiation.

This investigation has not been continued long enough nor on a sufficient number of cases to allow one to draw final conclusions as to its value. It is presented as a preliminary report of an additional method of radiotherapy of carcinoma of the cervix. It is fairly easy of execution for any trained surgeon and the risk to the patient is not very great. On the other hand the method is capable of placing the source of radiation in intimate contact with carcinomatous tissue everywhere. In combination with correct high voltage roentgen therapy it ought to improve considerably the therapeutic results in the advanced inoperable conditions, particularly when the broad ligaments and the spaces between the uterus and the bladder and the uterus and the rectum are involved. Since, as stated above, in this type of cases with the best methods of radium and roentgen therapy employed at present less than 20 per cent may be benefited, it is imperative that this additional method of intraperitoneal insertion of buried capillary glass tubes be given a thorough trial.

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TREATMENT OF NON-MALIGNANT UTERINE CONDITIONS*

BY GEORGE F. THOMAS, M.D., AND WALTER C. HILL, M.D.

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TEN years ago we found it necessary to discuss at great length and with the support of all available statistics, the relative value of radiation therapy in the treatment of uterine fibroids as compared with surgery. At that time our personal experience and a survey of the literature led us to conclude that unless there were complications which definitely indicated the need of operation, radiation was the method of choice.

At the present time, it is sufficient to state that we have found no reason to change our attitude, except to eliminate some of the contraindications.

The safety and efficacy of radiation treatment is now firmly established. Nevertheless, we find that a large percentage of men engaged in the practice of medicine are not so familiar with this fact as they should be, in view of the number of good results reported in the literature.

The fact that about 20 per cent or more of women over thirty-five years of age have benign tumors, most of which are fibromyomata of the uterus renders the question of the proper method of treatment an important one. Many authors claim that most of these tumors remain small and give rise to no untoward symptoms and tend to disappear with the menopause. Nevertheless, Bland-Sutton, in his comprehensive monograph, states, that "although uterine fibroids have remained for many years without producing more than temporary inconvenience, the number which remain harmless forms a very small minority."

Most women will undergo a long period of invalidism before they consent to hysterectomy. Myomectomy is indicated only in those cases where the patient is willing to risk the possibility of complications and of subsequent operations rather than deprive herself of the possibility of a successful pregnancy. It is not, even in these cases, a very satisfactory procedure. To quote Bland-Sutton again;

* Read at the Fifth Annual Meeting, Central Section, American Roentgen Ray Society, Indianapolis, Ind., Feb. 23, 1924.

"Experience teaches this stern lesson, after the enucleation of a fibroid in the procreative period of life, a women is more likely to grow another fibroid than to conceive successfully."

If it were generally known that practically every patient suffering from uterine fibroid could be, to all intents and purposes, cured of the lesion without any danger, without any appreciable inconvenience or interruption of the usual routine, whether of occupation or pleasure, it is certain that this method would be chosen whenever possible in preference to any other. Operation should be recommended only when other measures plainly cannot relieve the symptoms.

It is significant that many prominent surgeons and gynecologists have practically discontinued operating on these cases and have installed roentgen equipment in their clinics or have supplied themselves with radium to treat them.

A summary of the accumulated observations of many men will bear more weight than the observation of any one individual in regard to his own experience. For this reason we quote the following statement: "A review of the literature shows a total of 1099 cases of fibroid treated by radiotherapy by nine different men. A percentage of 95.5 per cent of cures was obtained."[1]

When we say "cure" in this article, we mean relief of symptoms, not necessarily the complete disappearance of the tumor, although in most cases the uterus will be reduced eventually to normal size. Even in the large fibroids, relief of pressure symptoms occurs almost immediately. The tumor rapidly diminishes in size. We have had several cases in which a tumor extending up to the umbilicus diminished to half the original size in less than two months after treatments were started. The subsequent diminution may not take place at the initial rapid rate, but in the cases that had sufficient radiation, it continues progressively for a long time after the treatments have been discontinued.

The menopause produced by radiation is not usually any more severe than the natural menopause. It is very rarely that patients complain much of the associated symptoms. It is also important to note that patients do not seem to experience any change in their natural sexual desires, nor do they show any of the changes that are popularly supposed to accompany castration, such as change of voice, features and general appearance.

The following case presents many features of interest, illustrating more clearly than can be described, the results that may be expected from radiation therapy.

CASE REPORT

Mrs. B. A. B., aged forty-five, with a family history of hemophilia. As far as the patient knew all the males in the family were bleeders and all the females bled far more profusely than normal. Both mother and grandmother had very severe hemorrhages at the time of menopause. The patient and some of her female relatives suffered from frequent and copious epistaxis, especially at the time of the menstrual periods.

When the patient was referred to us she was very anemic from profuse and almost continuous bleeding. Her pulse was irregular, her weight was 130 pounds, 30 pounds below normal. Examination showed multiple large fibroids, one on the left side reaching almost to the umbilicus.

On account of the patient's condition, operation was considered inadvisable. Roentgen therapy was started Nov. 9, 1919. Treatments were given through 5 portals, 3 areas anteriorly the first day and 2 areas posteriorly four days later. On account of the patient's condition, a mild dosage (about 60 per cent of an erythema dose over each area) was given with the following technique: approximately 126 kv. peak voltage, filtration 4 mm. Al plus 2 layers of thick leather, 8-in. skin-focus distance. This series was repeated 3 weeks later, Dec. 3 and Dec. 5. At this time the patient reported she had had no hemorrhage recently, and the tumor was definitely smaller. She had gained weight and improved in color.

On Dec. 23 she reported that she had had a period starting Dec. 9 and lasting two weeks. It was severe, but she had no

[1] TAUSSIG, FRED J. In what cases do uterine fibroids still require operative removal? *J. Am. M. Ass.*, 1921, lxxvii, 357. (Abs. in AMERICAN JOURNAL ROENTGENOLOGY, 1922, ix, 700.)

pain as she had had previously. The tumor was about one-half the original size. Subsequent treatments were given through 12 portals of entry with slightly increased dosage through each portal. In all, five series were given, with intervening 3-week intervals. The January period was missed. She had had no hemorrhage during the past month.

On Jan. 1, 1920 she reported that she had gained 20 pounds in weight. The tumor was about the size of an orange.

Seven months later she advised us that she had had a slight occasional bleeding. The tumor was barely palpable.

Feb. 20, 1924. Patient reports that she has been in the very best of health for the last four years. Has very good color and weighs 160 pounds. Her heart has stopped bothering her and her pulse is regular. She firmly believes that she has had less discomfort from menopause than most other women. There has been no hemorrhage or bleeding of any kind since 1920. She furthermore states that she has experienced no change whatsoever in sexual characteristics. A small nodule the size of filbert is palpable on the left wall just above the cervix. Otherwise the uterus appears normal in size.

Although the results secured with the longer wave-length roentgen rays, as used in the above case, were very satisfactory in most respects, there were several reasons which led us to consider that it would be advisable to change to a short wave-length technique. Before considering these it will be necessary to dwell briefly upon the mechanism of the action of radiation in uterine fibroids, for one's technique would obviously depend upon his conception of this mechanism. If the opinion is accepted that decrease in size of a fibroid is entirely an indirect result of the effect of radiation on the ovaries, then it is obviously desirable to concentrate the dosage over the ovaries and give merely the amount of radiation necessary to produce an artificial menopause. On the other hand, if it is believed that radiation has a very appreciable effect directly on the tumor itself, it becomes necessary to give homogeneous radiation of sufficient intensity throughout the entire tumor mass. Although it is generally considered that the action of primary importance is that on the ovaries, there are several reasons for believing that the effect on the tumor itself is of no little importance. The fact that radiation of the entire tumor mass by roentgen rays, in large tumors, is more efficient than radium in spite of the production of the menopause by the latter, indicates this. Furthermore, if the continuation of the ovarian secretion alone controlled the continuance of a fibroid, one would expect all fibroid to disappear or markedly decrease in size after the occurrence of the natural menopause, or that produced by the administration of a castration dose by radiation.

We have assumed in our own work that the effect on the tumor mass was of considerable importance and therefore it was necessary to radiate the entire growth. It was on this basis that we formerly divided the entire field into areas 10 cm. square, the number varying with the size of the tumor, giving over each area an erythema dose. With the technique then employed, (130 kv. peak voltage and filtration of 4 mm. Al and leather, at a distance of 8 in.) we probably obtained somewhat less than 15 per cent, 10 cm. depth dosage. The results secured were quite satisfactory, but in patients having large tumors and in fat patients, a great number of treatments was required. With these repeated treatments, we found that the entire series covered rather too long a period. We furthermore found that after the first two or three treatments, the patients seemed to have become sensitized to radiation so that the treatments which at first caused no reaction, later caused a definite amount of nausea and indisposition. There is, of course, a great difference in patients in their reaction to radiation. Some patients experience very little disturbance even with the repetition of a massive dose while others are quite prostrated when a comparatively mild treatment is repeated.

For the reasons indicated above and also because we desired to get the required dosage into the ovaries and throughout the tumor with the least amount of exposure to the overlying tissues, we considered that it would be desirable to change to the use of short wave-length radiation. Fur-

thermore, to avoid failure in the larger tumors and to hasten the retrogression of the growth, it seemed advisable to give larger doses even than necessary, keeping, however, well within the limits of safety.

According to the size of the patient and of the tumor, we vary the voltage from 180,000 to 200,000, filtration from 0.8 to 1 mm. of copper and tube skin distance from 40 to 50 cm. With the higher voltage, and the heavier filtration, we estimate our effective wave length at 0.138, Å. U., the 10 cm. depth dosage being about 40 per cent. The erythema dose at 50 cm. focal skin distance is 520 ma.-min. with our standard tube.

In order to cut down the time of exposure, we prefer to utilize the higher voltage above mentioned and regulate our depth dose by change of filters. We realize that it is unwise in some respects to record actual details of technique, but it seems necessary to present some factors definitely for purposes of illustration. We presume that every roentgenologist using short wave-length roentgen rays will make the proper allowance necessary for varying equipment. In a patient who measures 37 cm. across the hips and 25 cm. anteroposteriorly with a somewhat triangular field measuring 20 cm. on each side with the apex toward the symphysis, with 200,000 volts, through 1 mm. Cu. and 1 mm. of Al, we would give 320 ma.-min. anteriorly and the same amount posteriorly. This would give (according to the Erskine charts) a dosage of approximately 60 per cent in the center of the pelvis. This dose given at one time might result in severe post radiation sickness. Accordingly we divide the treatment into four exposures with intervals of three or four days intervening. In most cases this will not result in any appreciable nausea, although after the final treatment the patient may have a short period of mild indisposition.

This dosage may be more than is required. It may be found that a somewhat smaller dose will result in sufficiently rapid decrease in the size of the tumor. The determination of this point will require a comparative study of a large series of cases treated with different doses. The ideal is to obtain the greatest possible diminution in size of the tumor in the shortest possible time, with the least possible inconvenience to the patient in respect to the number of treatments and with the least amount of radiation sickness. We are reporting this technique in detail in the hope that others will be stimulated to do likewise. A survey of the literature up to the present time does not indicate very clearly the exact dosage requirements for uterine fibroids. Many appear to think the so-called castration dose is sufficient.

With our conception of the action of radiation as above stated, it is obvious that as a rule we prefer the use of roentgen rays to radium.

In many cases, the elimination of anesthesia and even of the short period of confinement in a hospital is grateful. There is, however, a very definite field for the use of radium, especially in those cases where curettage is indicated for diagnostic purposes and in patients whose age would render a future pregnancy impossible, in whom, therefore, any change in the intrauterine structure would be of no consequence. If radium is used in the larger tumors, we would consider it advisable also to give additional radiation by means of roentgen rays. We appreciate the fact that radium is an easier method for gynecologists to use personally and that consequently it may be accorded more popularity. We venture the opinion, however, that in those clinics where both radium and high voltage therapy are as readily available, there will be a growing preference for the use of roentgen therapy in most cases.

We have not found that a mild inflammatory condition of the uterus and adnexa was a definite contraindication to the use of roentgen radiation. On the contrary, we have found that after radiation, some of these cases cleared up in the same way that some other infectious processes respond to roentgen treatment. Cases, of course, should be carefully selected. It seems more accurate to say that in certain cases operation is indicated, rather than to say roentgen radiation is contraindicated.

It is frequently stated that uterine fibroids should be removed surgically because of the possible complication with

malignancy. This opinion does not seem logical in view of the fact that the mortality rate from hysterectomy is about as large as the percentage of the coincidence of malignancy and fibroids, and especially, in view of the poor surgical results in cases where malignancy does exist. Even if there is indication of malignancy, the wisdom of operative procedure is doubtful. Combined radium and roentgen therapy will probably give better results.

We have not found that size, *per se*, was any contraindication to roentgen therapy. Some men have reported that operation should be resorted to in fibroids larger than 12 cm. in diameter. A fair proportion of the uterine fibroids which we have treated have been larger than this, several having reached as high as the umbilicus. In any case where complications arise due to acute pressure, operation may obviously be necessary.

The fact that amenorrhea can be produced by comparatively mild roentgen treatment, makes this method preeminently the one that should be used in the treatment of excessive or prolonged uterine hemorrhage, in which the usual medical and surgical procedures have proved of no avail and in which there is no objection to the production of a permanent menopause. In those cases of idiopathic menorrhagia in young women that do not respond to the usual surgical measures, the hemorrhage can practically always be controlled by radiation and in many cases without producing more than a temporary amenorrhea. In these cases when the menses start again they are likely to be normal. A few cases have been reported where a patient subsequently gave birth to an apparently normal child. In view of this possibility in these cases roentgen radiation is preferable to radium, even mild doses of which, according to Corscaden[1] may cause dystocia. In younger women the dosage should be less than the castration dose. If the condition does not clear up, additional treatment may be given after the lapse of four or five weeks. It may not be possible to establish any exact dosage for these cases any more than one can establish an exact dose for a given medicine. There may be, and probably is, considerable variation in the sensitivity of the ovaries, varying with age and possibly with those other unknown factors that make some people at fifty as young as others half their age.

The best time to give treatment in this condition, as in uterine fibroids, is immediately after menstruation. The hemorrhage may be, and probably will be increased, immediately after treatment, but very quickly a marked improvement in the patient's condition takes place. In those patients in whom it is impossible because of constant flowing to determine the normal time of a period it is advisable to give very mild treatments, that is, even the castration dose is divided into two or three exposures. With these divided treatments results can usually be secured without special post radiation sickness.

In metrorrhagia associated with the menopause, not due to malignancy, there is no objection to giving a full castration dose.

In conclusion, we wish to state that we believe that short wave-length radiation presents numerous advantages over long wave technique, especially in the treatment of large tumors and stout patients. A full dosage can be given in a shorter time with less exposure to the overlying structures, with less inconvenience to the patient and with quicker results.

[1] Corscaden, James A. Statistics and technique in the treatment of fibromyoma of the uterus by radiotherapy. Am. J. Roentgenol., 1922, ix, 812–820.

LATERAL ROENTGENOGRAPHY OF THE LUMBOSACRAL REGION*

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RENEWED interest in the study of the lumbosacral region has been brought about by the use of the Potter-Bucky diaphragm. It is now possible to obtain lateral roentgenograms routinely in all cases requiring examination of this region. (Figs. 3–6).

It is remarkable that in the large number of cases examined for supposed lesions of the lumbosacral region in which a history of injury was obtained, in only a very few cases has it been possible to demonstrate any pathological change. However, numerous anomalies have been observed in this region. It is thought by some authors that an anomalous development of the spine renders an individual somewhat more likely to manifest symptoms following trauma. However, the history of the injury and the symptoms would require careful correlation with the roentgen findings to arrive at a proper conclusion in a particular case. The cases illustrated in this paper gave definite histories of injury to the lower back, but in only one case could a pathological change be made out roentgenographically (Figs. 10 and 11). In most medico-legal cases roentgen evidence of definite bone changes is absent and too much importance is usually attached to anomalies and variations from the normal.

Lack of well correlated statistics in regard to the exact anatomy in this region, as revealed by the roentgen ray, seems to warrant a contribution to the subject. This is especially true because the ordinary anatomical data regarding this region seems to be at great variance with the roentgen-ray appearance as observed in the living subject. For example, the usual anatomical diagrams depict the lumbosacral curve as showing less departure from a perpendicular than is actually the case in a series of lateral roentgenograms of this region. The lumbosacral angle, that formed by the anterior border of the 5th lumbar and the first segment of the sacrum (Figs. 2 & 6AA & BB) measures 32° in one anatomical diagram and 34° in another. Some of the more recent textbooks on lesions of the spinal cord show cross sections of the lumbosacral region which are more nearly in agreement with the roentgen appearance. Testut, for example, depicts a cross section giving a lumbosacral angle of 45° (Fig. 2) and Frazier an angle of 59°. It is possible that some of the errors in depicting the anatomical appearance of the lumbosacral region may have arisen from the fact that in the newborn, according to a section in Lovett's book on curvature of the spine,[1] a very small lumbosacral angle, 35°, is illustrated (Fig. 1). It is possible that, as the spine takes on adult characteristics, the angle is considerably increased in some individuals and that this fact has not been sufficiently emphasized in the past.

Charts of roentgenographic appearances based upon films made before the use of the Potter-Bucky diaphragm may also be questioned as to their accuracy. For example, the charts made for the use of the roentgenological department of the United States Army during the war show a degree of curvature of the lumbosacral region, 32°, which is less than that usually observed in lateral roentgenograms taken with the Potter-Bucky diaphragm, (Fig. 6AA & BB).

For the purposes of classification it has appeared necessary to make a study of certain angles. The study of the angle which shows the inclination of the body of the fifth lumbar vertebra has appeared to be most important. This angle is measured by drawing a line along the inferior border of the fifth lumbar vertebra and determining the angle which it forms with a horizontal line, representing the central

[1] Lovett. Lateral Curvature of the Spine and Round Shoulders. Third Edition. Figure 16, Page 23.

* Read at the Fifth Annual Meeting of the Eastern Section AMERICAN ROENTGEN RAY SOCIETY, Atlantic City, N. J., Jan. 24–26, 1924.

ray in exposures made in an anteroposterior position, drawn through the junction of the anterior border with the inferior border of the same bone (Figs. 2 & 6CX & DX).

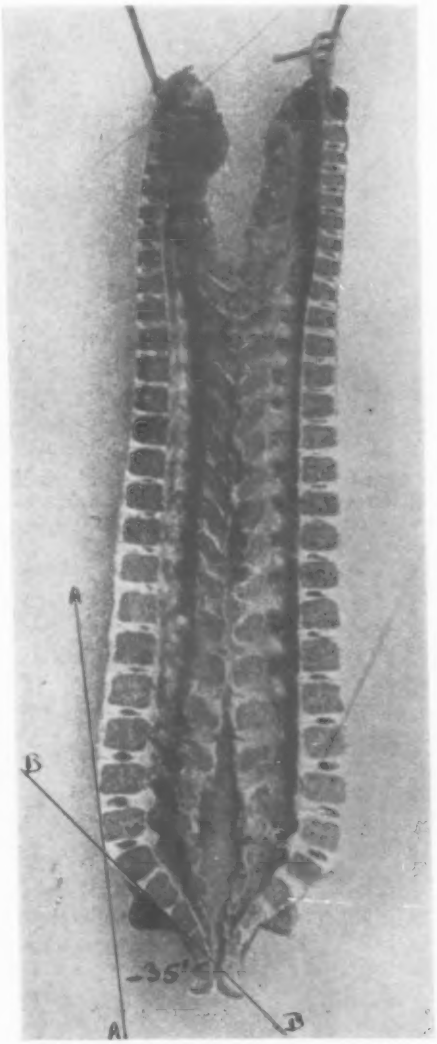

FIG. 1. Cross section of spine of a new-born infant (Lovett) with a lumbosacral angle of 35°, which is considerably less than that observed roentgenographically in the average adult. This would indicate that the lumbosacral angle gradually increases from childhood to adult age. Compare with Fig. 2.

One can roughly make two classifications; one in which the inclination of the fifth lumbar vertebra shows only slight departure from the perpendicular, and another in which there is considerable departure from a perpendicular (Fig. 8). It would obviously be wrong to attribute an increase in the departure from the perpendicular to an injury to the spine, but an erroneous conclusion of this sort is sometimes made from anteroposterior exposures in which this tilting of the fifth lumbar vertebra is attributed to a slipping of the vertebra. The lateral exposure in these questionable cases will invariably clear up the diagnosis and it will be observed that the relationship to the first portion of the sacrum has been maintained in spite of the extreme inclination of the fifth lumbar (Fig. 8). The relative space and variation in angle between the lower border of the fifth lumbar and upper border of the sacrum is fairly constant, while the variation in the inclination of the fifth lumbar vertebra and the angle between the anterior border of the fifth lumbar and anterior border of the sacrum

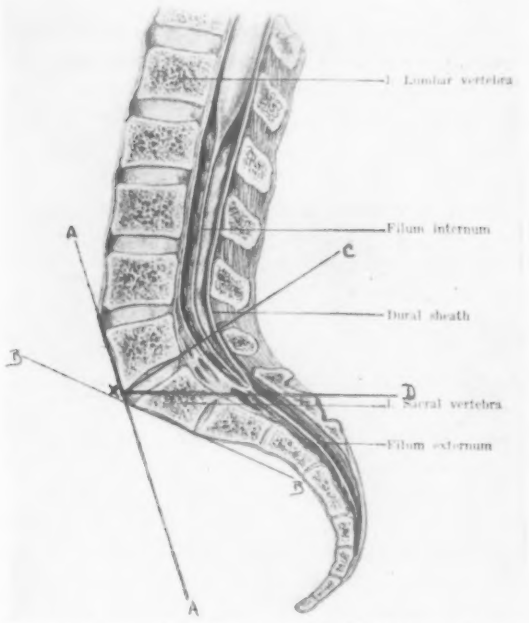

FIG. 2. Anatomical diagram (Modified from Testut) with a lumbosacral angle which is in accord with the roentgen findings in the average adult case. AA represents the anterior border of the 5th lumbar vertebra; BB, anterior border of 1st sacral segment. The angle formed by these two lines is 45°. CX represents lower border of 5th lumbar; DX, an imaginary line at right angles to the spine as a whole, intersecting the 5th lumbar at the junction of the anterior and inferior borders. The angle formed by these two, 30° in this instance, shows the inclination of the 5th lumbar vertebra.

varies greatly in normal indiviuals. This fact must be taken into account in recording the findings in this region.

FIG. 3. Case 1. Weight, 225 lbs.; anteroposterior diameter, 16 inches; lateral diameter, 14 inches. For lateral photograph see Fig. 4. For roentgenograms with Potter-Bucky diaphragm of lumbosacral region see Figs. 5 & 6.

FIG. 4. Case 1. The difficulties of a lateral examination are at times less than expected, for the lateral diameter may be less than the anteroposterior as in this case.

FIG. 5. Case 1. Normal lumbosacral region. Roentgenogram with Potter-Bucky diaphragm of a 225 lb. individual. For photographs see Figs. 3 & 4. For lateral roentgenogram see Fig. 6.

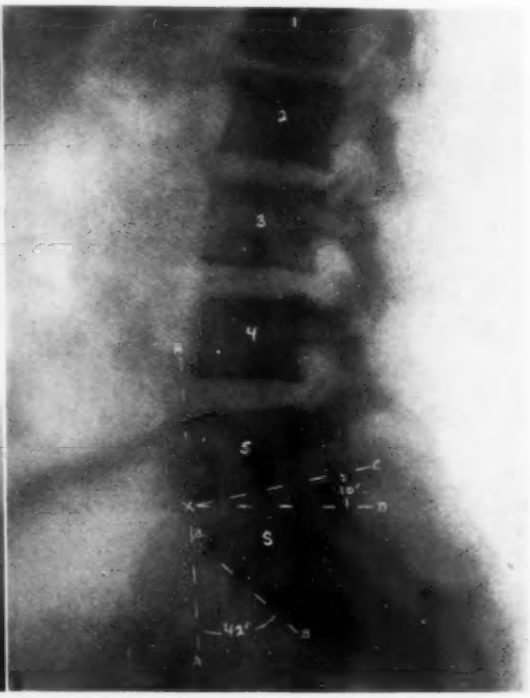

FIG. 6. Case 1. Lateral roentgenogram with Potter-Bucky diaphragm of 225 lb. individual. Lumbosacral angle 42°. Inclination of 5th lumbar 10′. In our experience these angles have been about the average.

FIG. 7. Case II. Low 5th lumbar vertebra and compressed appearance of upper portion of sacrum, which is at times erroneously diagnosed as spondylolisthesis. Lateral roentgenogram explains the appearance (Fig. 8).

FIG. 8. Case II. Lateral roentgenogram shows that the compressed appearance of the 5th lumbar and upper portion of sacrum noted in Fig. 7 is due to extreme inclination of 5th lumbar combined with a horizontal first sacral segment, which in the anteroposterior projection produces a marked foreshortening. No break in lumbosacral alinement. Lumbosacral angle 64°. Inclination of 5th lumbar, 35°.

FIG. 10. Case IV. Lumbosacral dislocation. Note shadow of body of 5th lumbar vertebra superimposed on that of 4th lumbar and first sacral. For lateral roentgenogram see Fig. 11.

FIG. 11. Case IV. Lumbosacral dislocation. Note diminished vertical diameter and extreme inclination of 5th lumbar vertebra with definite break in lumbosacral alinement, the sacrum being posterior to the body of the 5th lumbar.

In some instances it would appear that what has been described as the body of the fifth lumbar vertebra appearing superimposed upon the body of the sacrum may, in fact, be the shadow of the first portion of the sacrum itself lying in an almost horizontal position (Figs. 7 & 8). This appearance is particularly true when there is a low fifth lumbar vertebra, the upper border of which is well below the crest of the iliac bones (Fig. 7).

FIG. 9. Case III. Shadow of superior border of laminae of first sacral segment, indicated by arrows, in this instance is continuous with superior border of body of sacrum. In a previous examination, anterior border of sacrum was very indistinct and shadow of laminae was thought to be superior border of sacrum. Hence it was believed that there was an anterior displacement of the 5th lumbar vertebra.

In sacralization of the fifth lumbar vertebra it will be observed that on lateral exposure the anterior border of the fifth lumbar vertebra and the sacrum is continuous. This should never be mistaken for an acquired pathological condition due to injury.

When six lumbar vertebrae are present the anteroposterior projection may give confusing shadows owing to the overlapping of the fifth and sixth lumbar vertebrae and the sixth lumbar vertebra and the first segment of the sacrum. On lateral exposure, however, any pathological change which might be attributed to injury is easily excluded because of the even spacing and regular contour of the lumbar vertebrae and the sacrum.

Even the lateral exposure is not free from pitfalls in diagnosis. The superior border of the laminae of the first segment of the sacrum may cast a shadow which is continuous with the superior border of the body of the sacrum in such a way as to give the impression that the relationship between the fifth lumbar vertebra and the sacrum has been disturbed, thus leading to an erroneous diagnosis of lumbosacral dislocation. Such a diagnosis was recorded in a case which came to the attention of the writer. Confirmatory examination led to a correction of the error (Fig. 9).

In actual dislocation of the lumbosacral joint the lateral projection demonstrates the condition in a most striking manner and leaves no doubt as to the diagnosis (Fig. 11). While in the anteroposterior projection the body of the fifth lumbar vertebra may appear superimposed on the upper portion of the sacrum (Fig. 10), this condition may be simulated by an unusually low fifth lumbar showing extreme inclination associated with a large lumbosacral angle (Figs. 7 & 8).

The technique at the United States Veterans Bureau, at which place these cases were examined, is as follows: for an average size person, 7¾ inch point spark gap, 50 ma., 24 inch distance, about 2 seconds' exposure with superspeed films and Bucky diaphragm.

CONCLUSIONS

1. The lumbosacral angle varies greatly in healthy individuals.

2. At birth the angle is considerably less than that observed roentgenographically in the average adult.

3. The diagnosis of lumbosacral dislocation should never be made from an anteroposterior exposure alone. Lateral exposure may show an inclination of the 5th lumbar combined with a practically horizontal

first sacral segment which produces a marked foreshortening in the antero-posterior exposure.

4. In medico-legal cases, no matter how severe the trauma, one should always guard against the assumption that the trauma necessarily produced a particular variation from the usual anatomical appearance and no case should be decided without the aid of lateral roentgenograms.

SUMMARY OF THE CLINICAL RESULTS AFTER IRRADIATION OF CANCER OF THE CERVIX UTERI*

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THE following is a summary of results of 416 cases of cancer of the cervix treated by radiation. Most of these cases herein reported were treated by the application of radium in the cervical canal in combination with high power roentgen ray from the outside with the following results.

FIG. 1.

In this paper the cases are classified in four groups.

Group 1: All lesions of the cervix which are entirely confined to the cervix with no extension into the fornices or vaginal mucous membrane, as seen in Figure 1.

Case No.	Admission Date	Date Clinically Well	Length of Time Well to April 1, 1924
6056*	Jan., 1920	(Died 1921)	
6068	Jan., 1920	Mar., 1920	4 years
6147	Apr., 1920	July, 1920	3 years 9 months
6266	July, 1920	Aug., 1920	3 years 8 months
6389*	Oct., 1920	Dec., 1920; recurrence June, 1923 July, 1923	(2½ years) 9 months
6509	Dec., 1920	Aug., 1921	2 years 8 months
B. F. S.	Dec., 1920	Feb., 1921	3 years 1 month
6851	May, 1921	June, 1921	2 years 10 months
7184	Oct., 1921	Nov., 1921	2 years 5 months
B. F. S.	Nov., 1921	Jan., 1922	2 years 2 months
461*	Jan., 1922	(Died April, 1922)	
509	June, 1922	Aug., 1922	1 year 8 months
7814	Dec., 1922	Mar., 1923	1 year
7839	Jan., 1923	Apr., 1923	1 year
7998	May, 1923	Oct., 1923	6 months

It will be seen from the above chart that there were 15 cases of cancer of the cervix falling in Group 1, of which 13 have been well for periods of from six months to four years.

Case No. 6056 died from the disease about eighteen months after treatment.

Case No. 6389 recurred after two and one half years, was again treated, and has now been well for nine months.

Case No. 461 died from a peritonitis due to a Neisserian infection which was aggravated by the radiation. It seems fair to regard this case as a mortality due to treatment (which has been less than 1 per cent in the whole series). Eliminating this case we have had a healing in

* Read before the Ninth Annual Meeting of THE AMERICAN RADIUM SOCIETY, Chicago, June 9, 1924.

thirteen cases out of the fourteen, or 93 per cent.

13 cases—Clinically well
2 cases—Died (one from peritonitis)
(one from the disease)
Total 15 cases.

Group II: All cases farther advanced in which a portion or all of the cervix is involved and the growth extends to the

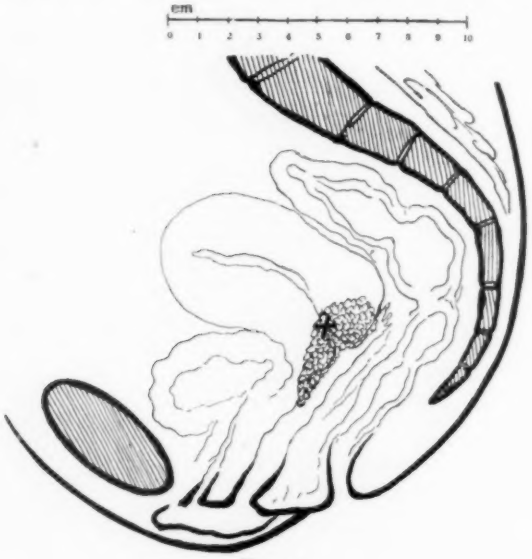

FIG. 2.

mucous membrane and walls of the vagina, as seen in Figure 2.

Case No.	Admission Date	Date Clinically Well	Length of Time Well to April 1, 1924
6007*	Nov., 1919	Dec., 1919	1 year 5 months
6304	Apr., 1920	Aug., 1920	3 years 8 months
6643	Feb., 1921	Mar., 1921	3 years
6718*	Mar., 1921	Apr., 1921; recurrence Apr., 1922	
		June, 1922	1 year 9 months
7142	Sept., 1921	June, 1922	1 year 9 months
7277*	Nov., 1921	Jan., 1922	2 years 2 months
7291	Dec., 1921	Jan., 1922	2 years 2 months
7326	Jan., 1922	Aug., 1922	1 year 8 months
580*	Nov., 1922	Apr., 1923	1 year
7820*	Dec., 1922	Jan., 1923; recurrence Aug., 1923	
		Oct., 1923	6 months
7978	May, 1923	June, 1923	9 months
690	Aug., 1923	Nov., 1923	4 months
693	Aug., 1923	Nov., 1923	4 months
7996	Sept., 1923	Nov., 1923	4 months
8195	Oct., 1923	Jan., 1924	3 months

There were 30 cases in Group II; the results were undetermined in three of these cases and percentages are based on the remaining cases.

Fifteen of these cases, or 56 per cent, have been clinically well for periods varying from 3 months to 3 years and 8 months.

Case No. 6007 died from a heart lesion in May, 1921.

Case No. 6718 recurred after one year and was again treated and has now been well for 1 year and 9 months.

Case No. 7277 was seen last in May, 1922 but according to letters received from her, she is still well.

Case No. 580 had a peritonitis following treatment from which she recovered.

Case No. 7820 recurred after 7 months and was again treated and has now been well for 6 months.

In this group we have one case reported at this time as improved. This case was admitted in February, 1923 and was pronounced clinically well in April, 1923. In January of this year she had a recurrence which was treated at that time and at her last visit showed improvement.

Five cases are reported as unimproved.

Six cases died. The average length of life for these cases was sixteen months; the longest palliation being 2 years and 3 months, and the shortest seven months.

15 cases—Clinically well
1 case —Improved
5 cases—Unimproved
6 cases—Died
3 cases—Undetermined
Total 30 cases

Group III: All cases in which the cervix and the mucous membrane of the vagina are involved and there is beginning infiltration of one or both broad ligaments with moderate fixation, as elicited by vaginal and rectal examinations. See Figure 3.

Case No.	Admission Date	Date Clinically Well	Length of Time Well to April 1, 1924
5916*	July, 1919	Dec., 1919; recurrence June, 1920.	
		Sept., 1920	3 years 6 months
B. F. S.	Nov., 1920	Jan., 1921	3 years 2 months
B. F. S.	Nov., 1920	Mar., 1921	3 years
668*	Dec., 1920	Jan., 1921; recurrence July, 1923.	
		Aug., 1923	8 months

Case No.	Admission Date	Date Clinically Well	Length of Time Well to April 1, 1924
B. F. S.	Feb., 1921	Mar., 1921	3 years
6604	Jan., 1921	Mar., 1921	3 years
6916	June, 1921	July, 1921	2 years 8 months
6940*	June, 1921	Nov., 1921	2 years 4 months
7165	Oct., 1921	Jan., 1923	1 year 2 months
7169	Oct., 1921	Apr., 1922	2 years
7242*	Nov., 1921	Dec., 1921	2 years 3 months
7201	Oct., 1921	Sept., 1922	1 year 6 months
7259	Nov., 1921	Dec., 1921	2 years 3 months
480	May, 1922	June, 1922	2 years 9 months
493	May, 1922	Aug., 1922	1 year 8 months
8048*	Sept., 1922	Dec., 1922; recurrence June, 1923. Nov., 1923	5 months
7810	Dec., 1922	Mar., 1923	1 year
597	Jan., 1923	Mar., 1923	1 year
7873	Feb., 1923	July, 1923	9 months
505	Mar., 1923	Nov., 1923	4 months
8011	June, 1923	Aug., 1923	8 months
8148	Sept., 1923	Nov., 1923	4 months
8306	Oct., 1923	Dec., 1923	3 months
8249	Nov., 1923	Jan., 1924	3 months
748	Jan., 1924	Mar., 1924	1 month

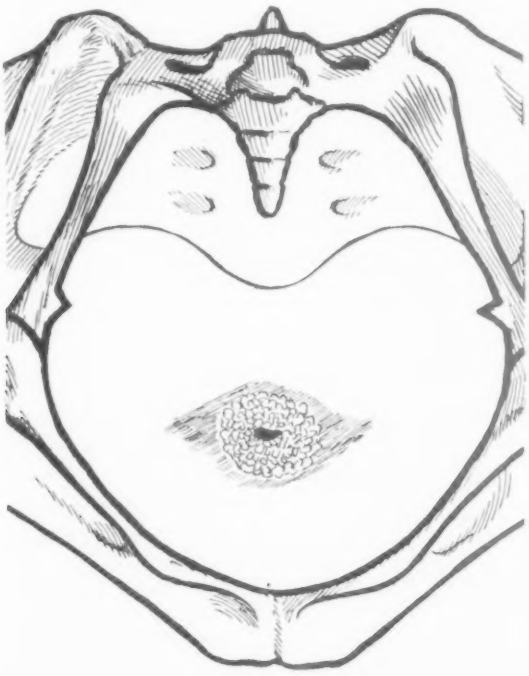

FIG. 3.

There were 118 cases in Group III; the results were undetermined in 26 of these cases, and percentages are based on the remaining cases.

Twenty-five cases in Group III, or 27 per cent, are clinically well for periods varying from 1 month to 3 years and 6 months.

Case No. 5916 recurred after 6 months and was again treated and has now been well for 3 years and 6 months.

Case No. 668 recurred after two and one half years and was again treated and has now been well for 8 months.

Case No. 6940 has no local recurrence but has a paraplegia.

Case No. 7242 has tuberculosis of the lungs.

Case No. 8048 recurred after 6 months and was again treated and has now been well for 5 months.

Eleven cases are reported as improved; twenty-nine as unimproved and twenty-seven died. The average length of life in these twenty-seven cases was 9½ months; the longest palliation being 3 years and 10 months and the shortest, 1 month.

25 cases—Clinically well
11 cases—Improved
29 cases—Unimproved
27 cases—Died
26 cases—Undetermined

Total 118 cases

Group IV: All cases which are exceedingly far advanced, in which the cervix, upper end of the vagina and both broad ligaments are markedly infiltrated, causing complete fixation of the uterus in the pelvis. See Figure 4.

Case No.	Admission Date	Date Clinically Well	Length of Time Well to April 1, 1924
7931	Mar., 1923	Aug., 1923	8 months
8184*	Oct., 1923	Jan., 1924	3 months

Case No. 8184 was a recurrent case, a growth having been removed from the cervix in October, 1921, and a hysterectomy performed in April, 1922. At the time of her admission in October, 1923, there was tumor tissue present which proved on biopsy to be mucous membrane epithelioma.

There were 253 cases in Group IV; the results were undetermined in 45 of these cases. Five cases, which are current cases, are reported as improved; 95 as unimproved, and 106 have died. The average life for these cases was 8½ months; the longest palliation being 3 years and 10 months and the shortest 1 month.

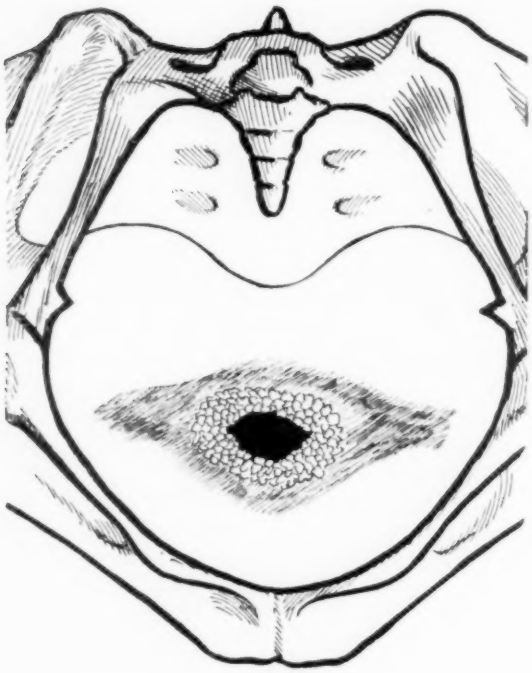

FIG. 4.

2 cases—Clinically well
5 cases—Improved
95 cases—Unimproved
106 cases—Died
45 cases—Undetermined

Total 253 cases

PERCENTAGES OF CLINICAL HEALINGS

Group I..... 93 per cent clinically cured
Group II..... 56 per cent clinically cured
Group III..... 27 per cent clinically cured
Group IV.....

CONCLUSIONS

1. The results in the treatment of cancer of the cervix in the so-called operable class, namely those cases in Groups I and II, are as good or better than the surgical treatment.

2. In farther advanced cases (inoperable) the results have surpassed what one could expect by surgical treatment.

3. Cases falling in Group IV have yielded palliation which lasted from a few months to three years, but resulted in death from the disease.

RADIATION IN THE TREATMENT OF CARCINOMA OF THE UTERUS*

BY

ERNEST CHARLES SAMUEL, M.D., AND ELEAZAR ROBINSON BOWIE, M.D.

Radium Institute of New Orleans — Touro Infirmary, New Orleans

THE brilliant results that first accompanied the use of radium in carcinoma of the uterus led the early users of this agent to think that at last we had a remedy in the treatment of the dreaded disease, carcinoma.

The application of radium began in our clinics at Touro Infirmary in June, 1916 with 125 mg. of radium element. Our immediate results were most gratifying, but, unfortunately, our early hopes were soon lessened because at that time we were probably overradiating the patients. We soon had the usual run of fatalities, sloughs, vesico-vaginal and vesico-rectal fistulae and one of the most distressing complications, proctitis. Our plan at that time was to give the patient 2400 milligram hours within four weeks. This dose was repeated in three weeks whether or not there was any indication. We know now that the simple tube applicators used at that time, with simple brass screening, were inadequate, as no attention was paid to distance filtration, emptying the bladder and rectum, and packing out the vagina, the application being simply placed against the growth and a pack put in, trusting the brass capsule to stay in place.

About this time, we started to see our distressing sequelae. At first we thought there were recurrences or extensions of the original growths, but soon realized that they were due to our technique. Bailey started the use of the "bomb" and we at once began the use of this efficient instrument in a modified way. Our immediate results were much better but we

* Read before the Ninth Annual Meeting of THE AMERICAN RADIUM SOCIETY, Chicago, June 9–10, 1924.

unfortunately again saw the cases begin to come back with the indefinite pelvic pains, bladder symptoms and the usual train that follows, no matter how late or how early the patient presented herself for treatment. Four years ago, we began the use of needles 10 to 12½ milligrams each, usually using about six needles placed in the cervix around the growth and about 50 milligrams placed in the cervical canal. When possible, this was allowed to stay in place for 24 hours and the patient instructed to return in four weeks for examination, and if the reaction was at an end, another application was made and she was asked to report in four weeks just for examination. If an extension of the growth was noted at this time, further radiation was useless as we have seen no case benefited that shows such an early recurrence.

For the past year we have used deep roentgen therapy in combination with radium but it is entirely too early to draw any conclusions.

I think we have tried to be as conscientious as possible in the use of radium, but I must say that I can not see anything very encouraging ahead. We have treated to date 219 cases and I do not think we have more than five 5 (excluding the cases of the past year) alive today and certainly not more than 10 cases that are free from symptoms. Only one of those living was originally treated more than 3 years ago. Only a few days ago, one of our prize cases who was free from symptoms for three years came in with a mediastinal growth extending into the right lung. It was most distressing to see this poor woman with no evidence of the local growth and with cervix and pelvis perfectly normal. I know you have all seen this occur and it is nothing new, but I think we must not expect too much from radium alone.

We have seen cases that were treated in clinics elsewhere that possessed over one gram of radium and where the emanation was placed in the growth and a large amount placed over the abdomen at the same time, and I must say the few cases we have seen treated by this method were not benefited any more than by the method we have used.

At this time, I do not wish to be misunderstood as decrying the use of radium in carcinoma of the uterus, because our patients are undoubtedly benefited. Life is certainly prolonged and the poor sufferers are made very much more comfortable, but we all know that radium is being purchased by doctors all over the country and is certainly applied in a very haphazard way, and we are all seeing cases come in far worse from the radium application than from the disease. I think this is all due to the glowing reports coming from different sources in this country where radium has only been in use on an average of two years.

Please remember that radium therapy does not consist simply in placing needles in or screened radium against a growth of the cervix. I have heard men say it is just as simple as putting in a tampon; usually they do not know what to screen out and by what method; they simply use the brass screens supplied to them by the commercial house whose literature tells them what filter to use. Their knowledge of the physical properties of radium usually comes from a visit to some clinic using radium or from one of the commercial houses giving a three or four weeks' course of instruction.

As a result of our experience with radium over this period of approximately eight years, we do not feel that we can conscientiously advise any patient or the physician in charge of any case that radium should be used where there is a reasonable chance to accomplish anything by surgical procedures. It is true that the majority of our cases have been of the advanced, inoperable type, but we feel that we have observed enough of the less advanced ones to be able to speak with some degree of assurance. We have seen no evidence in any of our patients of anything resembling a real cure or complete disappearance of the pathological process. An arrest of the progress of the disease, a more or less lasting dormancy of the condition, is the most we hope for from radium and it is for this very reason that we urge by all means surgical removal of the early focus wherever possible.

Of what value can it be to have a temporary feeling of security as a result of a tran-

sient arrest of the disease when we know from unfortunate experience of the hidden potentialities that we must expect at any time, either a recurrence at the original site or as the result of some metastatic process? Therefore, we would emphasize most strongly that in the treatment of carcinoma of the uterus, as in all other regions, in those cases where surgery offers something definite, radium should be used secondarily or pre-operatively, and the primary use of radium reserved for those definitely inoperable cases where the only real outlook is palliation.

Regarding the attached summary of results of our work, it is necessary to give a few words of explanation. The cases which have come to us have always been of the advanced type where surgery offered nothing or where surgery has first had its chance and, after failure, radium is called upon to accomplish that which the scalpel was unable to do. There has been this unfortunate lack of co-operation between surgery and radio-therapy all along but it is not felt that this is to blame for the results. Those cases we have treated which did seem to offer a chance have done very little better than the others, practically the only difference being in the time of the suspension of symptoms.

For about two years one of the members of the Radium Institute made it a routine practice to ligate the external iliacs in his cases where no other surgical procedure was justifiable and we began to feel that there was going to be a distinct improvement in our results. These cases did unusually well and improved more promptly as was to be expected from the decreased blood supply to the uterus. Metastasis was also appreciably delayed, but after about a year and a half we began to see that the improvement was one of degree alone, that the fatal issue was no less certain. Since the use of deep roentgen therapy in connection with radium we are again hopeful that our percentage of longer arrests of the disease will increase.

It is still encouraging to note the high percentage of cases where, at least temporarily, there is some improvement. This has lasted as a rule at least six months and some cases as long as two years, and has been the one encouraging factor in an otherwise very dark situation. This temporary benefit has followed, as we have all found, in cases now and then where we ourselves were absolutely hopeless of even palliation, and it is such a feature as this which gives us renewed interest and stimulation to continue.

Year	Total Cases	Living	Dead	Improved Temporarily	Unknown
1916–19	113	0	103	94	10
1920	37	0	37	32	0
1921	18	1	16	10	1
1922	25	4	17	14	4
1923	26	17	6	25	3
Total.....	219	22	179	175	18

MASSIVE DOSE RADIUM TREATMENT IN CARCINOMA OF CERVIX UTERI*

BY GEORGE ADAMS LELAND, JR.

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PRIOR to approximately four years ago, carcinomata of the cervix uteri were treated at the Collis P. Huntington Memorial Hospital by small fractional doses of screened gamma radiation. These applications ranged up to 5000 mc.-hr. per treatment were made directly into or against the cratered cervix, and were repeated at intervals of about three to six weeks.

There were found to be several outstanding disadvantages of that method. After the third or fourth treatment, there invariably occurred so much reactive edema that from then on it was difficult to determine how much of the induration present was malignant disease and how much was purely inflammatory. Accordingly, in most instances, the criterion for ending a series of treatments was the inability of the patient to come to the hospital rather than any definite estimate as to the local condition. The local tenderness always increased progressively, so that the later treatments were very painful. Likewise, a certain amount of contracture, which inevitably took place at the apex of the vagina after the first few treatments, rendered it impossible at subsequent applications to bring the radium into accurate approximation with the main focus of disease. From the economic standpoint, it was often a hardship for patients to travel back and forth from distant points.

Accordingly, repeated screened gamma treatments were abandoned, and since July 1, 1920, single massive doses of unscreened radium have been used.

The premises upon which this massive dose method has been based are as follows:

1. The scope of effective radiation is limited to such diseased areas as can be directly placed in contact with radium; namely, the portio vaginalis of the cervix, the cervical canal, the uterine canal and the vaginal walls.

2. Malignant disease in the broad ligament lymphatics and pelvic nodes is not susceptible to destruction by any form of deep radiation.

3. Malignant disease in any site and most particularly in the pelvis should be destroyed at one treatment en masse rather than by nibbling it away piece-meal.

4. Radium should be applied accurately to the area of malignant disease and not in a hit or miss fashion by blanket radiation.

5. The exact nature and extent of disease must be determined as accurately as possible and accordingly the application of radium should be under an anesthetic.

6. The dosage should be commensurate with the extent of the disease present and the individual resistance of the patient.

Results. As the empirical three-year period has elapsed for a portion of these cases, it is now possible to review critically this method and its results. The cases in this report were all treated at the Huntington Hospital between July 1, 1920 and July 1, 1921. There were 126 cases of primary carcinoma; 33 cases of recurrent carcinoma following complete hysterectomy; and 6 cases of carcinoma of cervix following supracervical hysterectomy. These 165 cases have been grouped according to the anatomical classification of the American College of Surgeons.

There were 4 cases of the 1 A or operable group, and 16 cases of the 1 B or borderline group. Of these, there are well, three years after treatment, without local or general evidence of disease 3 out of the 4 and 6 out of the 16—a total of 9 out of 20 cases, equal to 45 per cent. One case of the 1 A group had complete hysterectomy one and one-half years after radium treatment.

In the 1 C group with broad ligament involvement 5 are well out of 61. In the 1 D group with wide fixation, 2 are well out of 49. Thus the grand total for all primary carcinomas of the cervix is 16 well cases out of 126, equal to 12.6 per cent.

The presence of 7 well cases in the two groups where the broad ligaments were

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found to be involved would seem to vitiate the premise that malignant disease in the lymphatic tissues is not permanently affected by external radiation. This apparent inconsistency is to be explained by the inevitable errors which may occur in the differential diagnosis between malignant and inflammatory disease of the broad ligaments, when examined by vagina and rectum.

As regards the remaining 110 primary cases not well, of whom 100 have been traced, there are 4 alive with disease and 96 are dead.

The single 1 A case, alive with disease, was explored for gall stones two and one-half years after treatment. Gall stones were found and likewise two metastatic nodules in the liver. Intra-abdominal palpation of the pelvis showed the uterus, ovaries and broad ligaments to be very much shrunken and atrophied and without evidence of disease.

There are no 1 B cases alive with disease.

There are two 1 C cases and one 1 D case, alive with disease three to three and one-half years after treatment.

In the 33 recurrent cases, i.e., following complete hysterectomy, there are 4 cases, well over three years, equal to 12.1 per cent. When treated, none of these well cases showed evidence of involvement deeper than the vaginal wall. All others who were more extensively diseased are now dead.

In the group of carcinoma of cervix following supracervical hysterectomy, there is one well case out of 6—equal to 16.6 per cent.

To summarize—165 cases
147 traced
21 well—12.7 per cent
4 alive with disease
122 dead

Technique. In this series the patients were given a short gas or gas-ether anesthesia. There was one exception in the case of a woman of forty-seven years who on account of asthma was unable to recline in any position, and accordingly received treatment under morphine narcosis. Specimens were removed for microscopic examination in practically all instances. All of the cases reported alive and well are supported by pathological examination.

The treatments have consisted of single applications of massive doses of unscreened radium emanation. A repetition of the application has been undertaken in only rare exceptions.

The dosage in the most favorable cases has averaged 5000 mc.-hr. per individual treatment. This total has been about evenly divided between emanation seeds left buried in the cervical tissue, and emanation tubes enclosed in steel jackets, placed in the utero-cervical canal for a maximum of 8 hours. In other words, for a treatment of 5000 mc.-hr. emanation seeds totalling 18 to 19 mc. have been implanted, and steel encased tubes totalling 300 to 800 mc. have been inserted for 3–8 hours. Small doses for long periods have been observed to produce more nausea than large doses for short periods.

The actual strength of the individual seeds that are buried has varied from 1 mc. up to 12 mc. It has been noted that the larger seeds do not destroy tissue over a wider radius than the smaller seeds but do produce more extensive destruction at the site of implantation. This concentration of radiation may, accordingly, cause a slough of normal tissue which is liable to be slow in healing over, and may possibly result in penetration of the recto-vaginal or vesico-vaginal septa. For these reasons, we have gradually receded from the larger buried seeds and now rarely implant seeds over 1½ to 2 mc. each in the cervix, using a sufficient number to make up the required total. In order further to safeguard against fistulae because of too deep implantation, each cervical trocar is made with a bulbous attachment ½ to 1 cm. from the tip. This acts as a safety wedge when the instrument is thrust into the tissue and renders it quite easy to gauge the extent of penetration.

The strength of the steel encased emanation tubes has varied from 20 mc. to 300 mc. each. It is preferable to use the largest tubes available as it is difficult to place accurately over 5 or 6 bare tubes within the utero-cervical canal. Furthermore, it has been found at times quite impossible to withdraw a larger number of tubes from

the uterus without having one or more become imbedded in the uterine tissue either at the internal os or just above. When the patient is under anesthesia at the time of radium application, the cervix is dilated sufficiently to ascertain the height to which the surface disease has extended. Oftentimes the cervix shuts down again very rapidly. In some of the earlier cases of this series where a large number of steel needles were used, occasionally one or two needles could not be withdrawn at the end of the treatment period, until a second dilatation under ether was undertaken. This rather embarrassing complication happens but rarely at the present time. When it does occur, the following procedure has been found to be very simple and effective. The thread attached to the needle is passed through the eye of a small uterine curette. The curette is then introduced into the cervical canal up to the point of impingement of the needle. The thread is rendered taut, and the curette pushed gently upward and inward. This manipulation disengages the tube from the uterine wall, so that withdrawal is readily undertaken.

The case referred to above where morphine narcosis was used on account of severe asthma was one of the early cases of the series in whom a needle was lost within the uterus. The thread was pulled off and all attempts at retrieving failed. The tube was 70 mc. strength, and accordingly, the patient received about 10,000 mc.-hr. more than was intended. She suffered severely from reaction but has now been well over three years and without fistulae.

In estimating the dosage to be used, it has been found unwise to give the maximum dose to every patient. Each individual must be considered from the point of view of age, general condition, cachexia, and degree of invalidism. A large dose will necessarily cause more reaction than a small dose, although this is not the only factor determining the reaction. When the extent of the disease precludes the possibility of eradication it is not justifiable to submit the patient to increased suffering from a heavy reaction and distressing fistulae. Accordingly, in cases where there is very extensive involvement of the broad ligaments with wide fixation or extreme vaginal disease, a dose equal to about one-third to two-thirds of the maximum has been used. Furthermore, in many instances recently where a mere sealing up of an ulcerated surface was all that could justifiably be attempted, a heavy screened treatment alone has been given. The patients remain in the hospital for two nights after the treatment. Very rarely is the hospitalization longer. Upon leaving, they are instructed to go home or to some place where they may be quiet for a week after the treatment. For a month they are advised to undertake as little physical labor as possible. This does not seem to be asking too much as four weeks is really the minimum time in which they would be hospitalized and convalescent from a surgical operation. If the patients follow out this regime, the reaction symptoms are much reduced and rarely extend over two to four weeks, although rarely they may last for as many months. Even at its worst it is very definitely believed that the discomfort in these cases is not as severe as the recurring discomfort which the patients underwent when repeated unscreened treatments were used.

Reaction to Radium. The reaction to heavy radiation has been found to vary a great deal in individuals with reference to time of onset, duration and severity. The symptoms are pelvic pain, bladder and rectal irritation and general malaise. The pelvic pain is often described as burning or boring in character and occasionally extends down the thighs. It may be very distressing and prolonged. This symptom, in particular, and the others in general are oftentimes difficult to foretell. Many times it has been puzzling to find that certain heavy doses failed to cause as much reaction as more moderate doses in other similar cases.

The conclusion has been reached that post-radiation reaction is largely in direct ratio to the amount of scar tissue present in and about the cervix and uterus. The immediate response of tissue to radiation is local swelling. When this swelling is resisted by scar tissue, tension results and pain is caused. Such a counteractive pro-

cess would seem to account very readily for the painful symptoms noted in cases where the cautery has antedated the use of radium, where repeated radium treatments have been undertaken, or where operative procedures or inflammatory diseases have resulted in scar tissue formation.

Next to pain, irritation of the colon and rectum seems to have been the most troublesome symptom. The usual manifestation is constipation with more or less tenesmus and passage of mucus. In a few instances ulcerative proctitis or colitis has been observed. The ulcerative conditions have been solitary and large in the vicinity of the cervix or small and diffuse higher up the rectum and colon. These conditions though very distressing have been transitory and have not so far as known contributed directly to the mortality.

The bladder symptoms following heavy radiation are not usually prominent unless there have been similar symptoms previously. They are usually to be explained primarily by infiltration of disease up toward the base of the bladder and secondarily by increased irritation from reactive swelling.

The formation of fistulae following heavy doses has been surprisingly infrequent. There were none in the 1A group. There were 2 recto-vaginal in the 1B group, both following a second repeated heavy treatment, and 1 vesico-uterine fistula appearing one and one-half years after treatment.

In the 1C group there were 2 vesico-vaginal fistulae. One of these came on within three months of treatment and was accordingly attributable to radium. The other occurred only after a lapse of two years in the presence of active disease.

In the 1D group, the figures become relatively inconclusive because of the lack of full data. There were 2 cases recorded with fistulae—one with both recto-vaginal and vesico-vaginal fistulae and the other with vesico-vaginal fistulae only.

Thus in the 126 primary cases of this series there were recorded 7 cases of fistulae. This compares very favorably with 9 cases of fistulae out of 142 primary carcinomata previously treated by repeated screened gamma radiation.

All cases are asked to report in three months after treatment for observation. Those of the favorable group invariably return at about this time. Others who were far advanced often do not have the strength to make the journey.

Examination of the patients after this interval shows the cervical and vaginal disease completely or almost completely destroyed. There is some evidence of fibrinous slough. The vagina shows no reaction other than edema beyond the limits of disease. There are no burns such as are noted after repeated gamma applications. The apex of the vagina already shows evidence of contracture so that observation by speculum is less satisfactory than at time of treatment. By rectum, there is always a considerable degree of reaction edema causing enlargement of the utero-cervical segment and thickening of the broad ligaments.

At the end of another three months the cervix or remnants will in the favorable cases be healed, of leathery consistency and movable. The utero-cervical segment will be shrunken and the ligaments quite free. The patients will have improved markedly in general health, strength and weight. In the less favorable cases there may be evidence of active disease at the apex of the vagina. The utero-cervical segment will be enlarged and the broad ligaments thick and hard, perhaps more so than at time of treatment. The general condition may be but little affected.

It is at this stage that striking difference is to be noted in the majority of the cases treated by a single destructive dose as compared to those in whom repeated screened gamma radiation has been used. In the latter cases the apex of the vagina is usually a hard cratered mass covered with slough, tender to touch and still productive of painful and distressing symptoms in rectum and bladder. The dilemma as to further treatment or not is at hand. Physically the patient does not feel well, and mentally, worry and concern for the future is evident.

In the former cases, the condition of the cervix and uterus is practically normal. The malignant process has to all outward evidence been destroyed and the patient

goes home psychically encouraged because no further treatment is to be undertaken.

Repetition of heavy unscreened treatment similar to the first has not been found effective. There are two exceptions to this statement in this series. They were among the first treated and in light of a more matured experience were rather undertreated at the primary application.

In all other instances, the second heavy unscreened treatment not only failed to eradicate the disease, but brought on very delibitating reactive symptoms. However, if at the end of six months or subsequently there was found to be bleeding vaginal disease, a series of 2 to 3 screened gamma treatments totalling up to 10,000 mc.-hr. were found to be effective and valuable as a palliative procedure.

COLLIS P. HUNTINGTON MEMORIAL HOSPITAL

TABLE OF RESULTS

Carcinoma Cervix Uteri—July 1, 1920–July 1, 1921

Class	Cases	Traced	Well	Alive with Disease	Dead	Per Cent Well	
1A	4	4	3	1	0	75.0	45.0
1B	16	14	6	0	8	37.5	
1C	57	54	5	2	47	8.7	
1D	49	44	2	1	41	2.0	
Total	126	116	16	4	96	12.6	
2B	7	6	4	0	2	57.1	
2C	11	9	0	0	9	0.0	
2D	4	4	0	0	4	0.0	
Total	22	19	4	0	15	18.1	12.1
3C	1	0	0	0	0	0.0	
3D	10	9	0	0	9	0.0	
Total	11	9	0	0	9	0.0	
4A	2	1	1	0	0	50.0	
4B	1	0	0	0	0	0.0	
4C	2	2	0	0	2	0.0	
4D	1	0	0	0	0	0.0	
Total	6	3	1	0	2	16.6	
Grand Total	165	147	21	4	122	12.7	

Cautery and Radium. The actual cautery was not used in this series at the time of application of radium, with one or two exceptions. Its use is not advocated when it is contemplated that irradiation will follow. When radium is not available, cauterization may be a very valuable palliative procedure. When radium is available, cauterization whether used prior to or at the time of application of radium necessitates additional hospitalization, prolonged etherization and increases the liability of phlebitis and pulmonary complications. Furthermore, the correct use of the cautery distorts the vaginal and cervical tissues to such an extent that the accurate application of radium is rendered difficult and sometimes impossible. The loss of tissue substance reduces, by so much, effective tissue screening. Accordingly, full dosage is more apt to produce fistulae, while fractional dosage defeats the primary purpose in the use of radium.

External application of radiation, either by means of screened gamma rays or roentgen rays through abdomen or sacrum was not undertaken in this series. A recent group of cases treated by the deep therapy machine has not been productive of encouraging results. It is admitted that this latter group is a small one and composed for the most part of advanced cases. It is possible that further studies of more favorable cases with perfected technique may make this procedure a helpful adjunct.

The cases of *recurrent carcinoma or carcinoma of the retained cervical stump* following incomplete hysterectomy, presented similar though somewhat more difficult problems in the use of bare tubes. Here the tissue screens of cervix or fundus or both have been removed. The pelvic viscera have become disturbed so that bladder and rectum may be very close to one another. Application of unscreened radiation for these cases is attended by grave danger of fistula formation. However, the principles and methods already enumerated for the primary cases were found to obtain in this group without essential modification.

In conclusion, the following points are emphasized:

1. Massive dose unscreened radiation is effective in eradicating carcinoma of the cervix. The maximum curative action of radium is thus obtained because of its immediate contact with the malignant tissues which are to be destroyed.

2. Massive dose unscreened radiation has been found at this clinic to be more effective, quicker and less debilitating to the patient than intermittent screened gamma radiation. The latter is now used only in those cases where palliation by surface healing is the objective.

3. The likelihood of fistula formation is not greater in unscreened radiation than in screened gamma radiation.

4. The adjunctive procedures of cauterization and external radiation have not been found to be of sufficient value to be used as routine.

THE TREATMENT OF INOPERABLE CANCER OF THE PELVIS BY RADIUM*

BY ALBERT SOILAND, M.D.

LOS ANGELES, CALIFORNIA

IRRESPECTIVE of the fact that a great deal has been written on radium and cancer of the pelvis there is still room for discussion of certain aspects of this important subject. This presentation will be limited to the inoperable cases who seek relief by other than surgical means.

It is the rule rather than the exception that the radiologist sees only the far advanced cases of pelvic cancer, and he must be ever ready to give to these unfortunates intelligent, scientific and humane service. To handle such cases to the satisfaction of the patient, the patient's relatives and friends, and to the physician who refers them, is not altogether easy, requiring patience, tact and much diplomacy. Frequently in our desire to relieve the mind of the sufferer, who is very often unaware of the serious nature of her affliction, we do not mention the word "cancer." We are usually urged by the near relatives and friends to make light of the matter, and cautioned not to divulge the true state of affairs to the patient. There are times when such evasion of the truth may be required, but this procedure is entirely unfair to the radiologist, and in many instances causes him great embarrassment. In one specific instance a suit of malpractice was instituted against a radiologist who, in order to carry out the desire of the relatives not to inform the patient of the true state of affairs, led the patient to believe that the pain and the rapid progress of the cancer was due to the momentary effect of the radium, and the very relatives who had urged this deception sued the doctor for an outrageous sum to recover for a mythical radium burn. This is one of the reasons why I believe that every patient should have a thorough knowledge of what is going on during the course of her treatment.

The physician or surgeon who refers a late, inoperable, incurable and totally hopeless case should inform all those interested of the true state of affairs. The patient should also know that she is very seriously sick. This will not throw the entire burden of responsibility upon the radiologist, as is now so often the case. Nearly every day it is my unpleasant task to face just such a problem because we have as yet failed to know and conquer cancer.

Not all cases however, are beyond hope of help, and we are really making some progress, if only to make the sufferer more comfortable and to render her remaining life free from the distressing symptoms which can only be mitigated by a proper recourse to radiation.

The inoperable cases fall into two broad groups, those limited to an area in which cures by radiation are possible, and those which have invaded other structures in the pelvis and in which only temporary or palliative results may be expected. Unfortunately, the first group, or those favorable for treatment, is not often available to the radiologist. Recent trend of events, however, shows that the conscientious surgeon today is just as anxious as the radiologist to begin radiation treatment in a condition of pelvic carcinoma at the earliest possible moment, and by far the larger number of instances of tardy treatment is due solely

* Read before the Ninth Annual Meeting of THE AMERICAN RADIUM SOCIETY, Chicago, June 9–10, 1924.

to the patient herself, who rarely consults her medical adviser until the disease has assumed a very serious aspect and the hope for cure is not great.

In regard to treatment, the patients in group one with single observable lesions which can be covered completely by the energy of radiation are amenable to arrest and cure. Even those where the initial lesion has grown by extension and not metastasized can be classified with group one, of which type there are a goodly number credited as cured. There is still a further border line group between one and two where even remote parts of the uterus have been invaded in which clinical cures have been secured.

The biological action of radiation is now pretty generally understood. The immediate problem of the radiologist is to use the radium in such amount and manner as investigation and experience have shown to give the best results. This would be a simple mathematical problem if we could measure the extent, area and depth of the lesion. Unfortunately, we can never know just how far the tissues are invaded, so we must apply a radiation dose sufficient to destroy all cancerous cells in the field we believe involved, and in the quickest possible time. An exact dosage formula can probably never be made practical on account of the constant variable factors which are present in every individual. Various authors suggest a total dosage for the destruction of a localized pelvic cancer which varies from three thousand to nine thousand milligram hours. Some suggest a little less, and some a little more than this amount. This, of course, refers only to filtered radium on or over the surface of the diseased area. Radium plunged or imbedded into the tissue substance naturally decreases the time element according to the quantity used. Such implantation is ideal in the cervix where the radium can be completely buried without endangering the bladder or rectal mucous membrane. In our clinic, unscreened radium is never permitted in any field where there is danger of invading healthy mucous membranes. We use fifty to one hundred milligrams for each application filtered with the usual 0.5 millimeters of silver, one millimeter of brass and one or two millimeters of rubber. Three thousand milligram hours, which is about the minimum efficient amount, are usually sufficient to thoroughly sterilize a given limited cancer field under such screening. With screened radium there is very little danger of producing a slough, and this makes it possible to utilize very large doses in our attempt to checkmate the ravages of an extensive carcinoma frequently involving the uterus, the adnexa, bladder and rectum. Thus, we have on occasions resorted to a total dosage of 20,000 mg. hours, combining internal applications with external radium packs.

Radiation to be effective in these cases has to be used to the limit of toleration of whatever normal tissues may exist in this environment. Fortunately, the drainage through the vagina is usually sufficient to prevent any great absorption of the products of radiation solvent so that even when massive doses, ten thousand or more milligram hours are used, there is rarely any systemic reaction. While no brilliant results can be claimed in these very advanced cases, the occasional recovery of patients so far advanced that it appears useless to attempt anything demands that we should at least make an attempt with this treatment in every case that presents itself.

Frequently we have had recourse to cauterization by the electric cautery to help remove the large masses of cancerous tissue after radiation and when this removal can be had without destroying the vesico-vaginal or recto-vaginal walls. When such a contingency is probable, cauterization is contraindicated. In all cases where we believe the cancer is localized, radium is considered all that is necessary. When, however, we are not sure of this point and in patients where the cancer has already reached the adnexa and extended or infiltrated beyond the cervix, we use in addition the short wave roentgen rays to the saturation point.

From experience in the past few years with a considerable number of patients with pelvic cancer, and having already seen several hopeless inoperable cases pass the five year cure period, we believe that radiation has made a step beyond that of any other method of combating carcinoma in this field.

ABSTRACT OF DISCUSSION ON PAPERS OF DRS. SCHREINER, SAMUEL, LELAND, AND SOILAND

Dr. Howard A. Kelly, Baltimore, Maryland. We are all keenly alive to the desirability of securing the best possible means of treating carcinoma of the cervix and body of the uterus. Many men are asking which is the best way to handle carcinoma of the cervix, surgery or radium, or are we to select our cases? I have spent a large part of my life, from 1882 until a few years ago, operating with good operative results. I have also spent a number of years recently in testing out radium, always being ready to resort to operation if necessary.

My conviction is that in practically all cases I prefer radium. Certainly radium comes first in my thoughts, operation second. If the patients live at a distance, as some place from which they have to travel for a week or ten days before getting to the coast, I operate, because we must keep radium patients under careful observation and see them every few months for several years. Radium sometimes cures extreme cases, *a fortiori* does it cure more limited cases, where the attack is more direct.

We must classify our cases a little better. A very superficial cancer may have remote metastases which we cannot recognize. I find from excellent clinics men send cases and say, "This is an operable case but if you think well, we would like to have you use radium," but upon examination I frequently find it inoperable rather than operable. This must be determined in all cases by rectal examination, and you cannot determine this matter in any other way where the disease has extended out through the cervix.

There are two ways of using the word "cure," first, the patient's sense. I tell the patient she is cured when I can find no more disease, no matter what the period is, but I also tell her that she must remain under observation for three to five years. From the patient's standpoint, let us use the word cure for keeping up the patient's hope.

Radium in the cervix is used in a very favorable situation. When we treat growths lying below the cervix we have to treat some normal tissues as well as the diseased, for we pass our treatment right into the wall of the tissues which envelop the diseased tissue. The early cases yield practically without exception to this treatment. Where the disease has extended out farther into the tissues I term them "borderline cases," and these are still readily irradiable. Then comes the group running back through the ileosacral ligament and in which the disease has gone beyond reach, certainly of surgery, and probably of radium. In such cases we are now implanting radium.

I agree with the gentlemen about the need of substantial doses. I usually employ 3000 mgm. hours if I am using radium emanation. The 10,000 mgm. hour dose I have never tried and would be afraid to because of the suffering from proctitis and rectal tenesmus. If others are using such large doses I will give the matter thorough consideration and if there are no bad results I may be glad to follow. I am glad to have substantial doses to implant, for we get much better results than with small doses. An hour is the extent of the time over which a treatment is extended. If the patient must go home I do not wish to see her for eight, ten or twelve weeks. I think we have been in the habit of getting our patients back too early. They should not receive another treatment as massive as the first, and we must plan to treat the residue of growth in some other way than by the massive dose.

Dr. Henry Schmitz, Chicago, Illinois. It is interesting to know that the results obtained by the Boston Clinic as well as at Baltimore are practically the same as those we get in Chicago. I believe that this survey shows one thing, and that is that the radium and roentgen-ray treatment of cervical cancer has come to stay. I cannot see how anyone can get around the fact that we must consider radium and roentgen ray therapy one of the recognized treatments for carcinoma of the cervix.

Dr. Douglas Quick, New York City. I feel a bit out of place in discussing this subject, but I might say just a word of our general impressions at the Memorial Hospital. I cannot quote the statistics, but they have brought the results in over 1000 cases up-to-date and they will be presented during the week. I can say, however, that their work does not conform to Dr. Samuel's remarks on the subject, for they have a very respectable group of cases beyond the five year period.

From these cases and the analysis of statistics up to the present we feel that the results in operable cases are distinctly better than those obtained from surgery, and that in inoperable cases the work has given a very good account of itself, so that the matter of surgery in the cervix is off the cards entirely. It is a matter for physical agents, and at present our efforts are centered upon how much we may gain in addition by adding heavy external deep therapy radiation.

Dr. Burton J. Lee, New York City. It may interest this body to know that at the meeting of the American Surgical Association, Dr. Greenough of Boston, Chairman of the committee to investigate the position of

surgery and radium, made a very extensive and flattering report.

His conclusions were that in the favorable and borderline cases the results from radium were comparable to those from operation. It was interesting to see his results reported with a surgical mortality of 35 per cent, while by radium there was no mortality whatever. Altogether the report created much interest in the Association, and it seemed to me the best resumé from the surgical standpoint of the whole radium subject that we have had up-to-date.

Dr. H. H. Bowing, Rochester, Minnesota. I might say that in Group I we place all cases that are limited to the cervical canal and the treatment is a surgical procedure. It usually means that a specimen has to be removed while the patient is under the anesthetic and if it proves to be carcinoma, amputation is done. If the growth is on the floor and is limited to the cervix we prefer to apply the pre-operative dose of radium, in such dose as will heal and practically return to the normal, and then allow sufficient time for all the benefits of radium to occur. This may vary from six weeks to two months. Then we reconsider the case and if it is considered a proper procedure a total hysterectomy is done. I do not have definite figures but my longest case is four years. Where the carcinoma is limited to the face of the cervix, although there are evidences of fixation or of lymph-nodes elsewhere, or extension to the vaginal wall or elsewhere, radium is the procedure of choice. Where there is massive involvement, of course we use radium alone, treating the case symptomatically and not trying to give intensive dosage. When the case is favorable to radium and limited to the face of the cervix we use 3,000 mgm. hours.

I wish to call your attention to the knee-chest posture for examination of cases, because to see the carcinoma disappear is much better than to feel it, and this method does away with traumatizing the part, which I think is most essential. Even removing the specimen may cause a rise of temperature, pelvic peritonitis, bronchopneumonia and death. By using the knee-chest position we do not traumatize and we can apply the radium most advantageously and run no risk of burying the radium in any place where it should not be. As the pathology diminishes the radium may be applied deeper, and as the area opens up we may advance our radium therapy so that the 9,000 mgm. hours is not applied to the whole canal at once, but 3,000 to the first inch, 3,000 to the next and 3,000 to the deeper portions of the uterine canal, figuring that the ordinary depth of the uterine canal is three inches. We may only be able to treat the first inch or the first two inches, but now and then we may get an opportunity to apply the radium to the entire canal. I have seen cases where there was no sign of a canal at the start but after the first treatment it will gradually come into view, and then you can advance the treatment to the next inch, and then on. We should not use the 9,000 mgm. hours in the first place treated, but by the broken dose method and applying the radium to different areas I am sure this massive dose can be given.

In the recurring growths we apply all the methods we know but I would admonish everyone not to try to do too much for the patient for sooner or later she will blame the advance of the cancer to the radium treatment. Do what you can and as the patient is gradually slipping from you stop the treatment.

All of our cases in Groups II, III and IV are treated with deep roentgen-ray therapy in addition.

Dr. Abraham Strauss, Cleveland, Ohio. Dr. Pomeroy and I have examined 1,000 cases of carcinoma of the cervix with the idea of seeing what effect the treatment has had on the various types of carcinoma. We followed the classification of epithelioma with pearls, epithelioma without pearls, the spindle cell, the basal cell, and the adenocarcinoma. The cases which responded best were epitheliomas with pearls. The most unsatisfactory cases were the spindle cell carcinomas, so we found that as the scale went down from the carcinoma with pearls to the carcinoma without pearls, the adenocarcinoma, the transitional cell and the basal cell, the first named were the most susceptible to radiation and gave the best results. We found that about 70 per cent of the transitional cell growths were clinically cured at the end of six months, but that at the end of twelve months the number had decreased and at the end of two years none remained well. It may be that these will need secondary treatment even though they seem to be perfectly well six months after the first application.

Dr. Bowing's remarks about the knee-chest position are interesting because in a patient we treated recently the only way we could see the growth was by putting her in this position and using an endoscope.

Dr. James Ewing, New York City. While I confess to an interest in many phases of this treatment of uterine cancer, perhaps my knowledge of the disease is limited mostly to its anatomy. I think Dr. Kelly touched the most important phase of the whole subject when he spoke of examining each case, and determining just what anatomical situation is present and

dealing with that. I find a great difference. I think one has to recognize at least three different classes of uterine cancer from the radiation and the surgical standpoints. One, the cauliflower, all on the outside, seldom following up the canal, very formidable looking, and the best results are secured by surgery and radium both. Another type is that which involves the cervical canal for a slight distance. That type I have seen very little of, but it has been pictured as running up the canal and even into the endometrium. There are such cases but they are very rare. I have seen very few cases that run far up or into the endometrium, and for that reason I have questioned the use of the silver filtered radium running away up in the endometrium. I have had several uteri removed after this treatment and all I find is intense superficial sloughing but with the growth still extending far out and not affected. Plenty of radium had been used but it had not reached the growth.

The most important and interesting group of all is that in which the growth develops deep in the cervical tissues and involves the parametrium before it involves the canal. The surgeon may remove the uterus but the growth promptly recurs, or the radiologist treats it without determining just where the growth extends and fails to get the radium in the right place. Since it is so difficult to determine just what the anatomy is, Dr. Kelly's rule about using massive doses is the only safe one, but it is an inaccurate rule, and I think some method of giving more study to the cases before attempting treatment should be employed. I think the blanket rule is the most unfortunate thing in the treatment of cancer today.

One point in regard to the late recurrences. Dr. Bailey thought it might be well to try to see what hysterectomy would do following recurrences. The first three uteri I got, to test the wisdom of this combination, were cases of very early although more or less bulky carcinoma. There was no infiltration and they were favorable from any standpoint, so I drew Bailey's attention to the point that if he was to test out the value of surgery after radium he should not use this type, but the borderline case which had already invaded the endometrium. To employ hysterectomy in the cauliflower type which can be treated well with radium would not prove anything. My own impression is, from observations drawn in the early period of this work, that hysterectomy, while capable of removing certain slumbering groups of cells, is quite likely to stir others up, but I am sure that hysterectomy may at times remove cells which might be the source of recurrence.

It seems to me that we have in the uterine group of cases accomplished a vast work. Dr. Lee referred to a report of the American Surgical Association on this subject which practically admitted that under proper auspices radiation had replaced surgical treatment, which was a good deal for the surgeons to admit, but everyone knows that the leading surgeons of the country are willing to accept facts when facts are presented. The only criticism I have of this treatment is that it is permitted to be done by men not directly concerned with uterine cancer.

Dr. Albert Soiland, Los Angeles, California (closing). I just wish to bring out a point that Dr. Ewing emphasized slightly. Since the surgeons are beginning to admit that there is an excuse for radiation in the treatment of cancer of the uterus, and that we can cure operable cancer of the uterus by radium, why not do as we are doing—treat every case of carcinoma of the cervix as though it were an extended and invading disease?

Dr. Howard A. Kelly, Baltimore, Maryland (replying to a question as to what filter he uses in 3000 mgm. doses). We use a brass filter 1½ or possibly 2 mm. thick, well coated with wax. Of course, we are depending upon the infiltration of the disease to prevent injury of the local parts.

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Information of interest to all readers will be found on page vii. Lists of officers of The American Roentgen Ray Society and The American Radium Society will be found on page preceding Editorial Section.

THE REGISTRY OF BONE SARCOMA

At the recent annual meeting of the American Roentgen Ray Society at Swampscott, Mass., Dr. E. A. Codman explained in detail the method of registering cases of bone sarcoma and secured the registration by members of the Society of a considerable number of well-studied cases.

The Registry of Bone Sarcoma is an activity of the American College of Surgeons begun in 1921, and Dr. E. A. Codman is the Chairman of the Registration Committee.

It is well known that our knowledge of bone tumors is in an exceedingly unsatisfactory state with regard to diagnosis and treatment. The registration is an attempt to secure information and material from a large number of cases in order that they may be studied collectively.

One of the first things revealed in this work was the confusion and multiplication of names which renders the entire nomenclature of bone tumors obscure and oftentimes misleading. By the careful study by a joint committee of the Registry of Bone Sarcoma and the Clinical Pathologic Association of the cases now registered a simple but at the same time comprehensive classification has been recommended. The study has already furnished much information which will result in improvement in diagnosis, prognosis and treatment.

Attention is called to an article by Dr. Codman in Surgery, Gynecology and Obstetrics, May, 1924, pages 712–721, in which the reasons for registration are reviewed, the new classification is given, with a description of the tumors of each class, and detailed directions supplied regarding the method of registration. The following is quoted from the above article, "The Registry needs the cooperation of roentgenologists as much as that of pathologists and surgeons. The hope of early diagnosis rests especially with the roentgenologist. Furthermore in the opinion of our committee a roentgenologist is quite justified in treating a case of bone sarcoma without help from the pathologist or the surgeon, but to be fair to his patient and to future patients with this disease he should register his case."

It was shown by the relatively large number of cases registered at the recent meeting of the American Roentgen Ray Society that roentgenologists can greatly assist in this work by registering their cases. Complete information regarding the method of registry may be obtained directly from Dr. E. A. Codman, 227 Beacon St., Boston, Mass.

THE DIFFERENTIAL DIAGNOSIS OF CENTRAL BONE LESIONS

Many authorities will not accept the classification of bone lesions into central and periosteal, but the continued study of bone diseases by clinical and roentgen examination and at the exploratory operation emphasizes the importance of

classification into these two fundamental groups.

A central tumor, in its onset, has an intact bone shell, and as it grows, it expands the shell. In the great majority of central lesions we see no evidence of new bone formation outside the bone shell. Quite frequently the central lesion may completely destroy the bone shell but this is not evidence of malignancy. Even after such destruction, on palpation and in the roentgenogram the tumor remains circumscribed, although it has lost its envelope of bone. The complete destruction of the bone shell is seen more often in the giant-cell tumor, which is, on the whole, the most common lesion of the adult bone at the epiphysis. In ostitis fibrosa—the bone cyst—the bone shell may be perforated, but it is rarely completely destroyed. The tendency in ostitis fibrosa is to spontaneous ossification and healing, and if there is no fracture, this ossification is always within the bone shell. If, however, the bone shell is fractured or crushed by accidental or operative injury, then the healing takes place as in an ordinary fracture, but I have never observed excessive periosteal callus or ossification.

The tendency in myxoma is to complete destruction of the bone shell without bone formation, either central or periosteal.

In the chondroma, as it grows and expands the bone shell, cartilage may perforate the bone shell and produce a reactive ossification in the periosteum. In cases of this kind, in the roentgenogram, the shell of bone is thicker and has a fuzzy appearance. This thickness of the bone shell with new bone formation, both on the central and periosteal side, I have never seen except in chondroma, and usually when it involves the shaft rather than the epiphysis.

Tuberculosis and chronic pyogenic osteomyelitis (Brodie's abscess) may so insidiously replace the marrow and cancellous bone by caseous material, pus or granulation tissue that the surrounding bone thins and expands, so that it looks very much like the bone shell in bone cysts or giant-cell tumor. As a rule, however, there is some thickening on the periosteal side of the bone shell with bone formation.

Now that we are seeing bone lesions earlier, central sarcoma resembling in the roentgenogram the giant-cell tumor or bone cyst is *very unusual*. Central sarcoma is more frequent in the experience of many surgeons and clinics because a certain proportion of benign giant-cell tumors are microscopically different from the common type. The difference is not in the giant cells, but in the tissue in which the giant cells are imbedded. When these patients are followed, the results are the same as in the benign giant-cell tumor. There may be a malignant giant-cell tumor, but many of us who have been studying this group for a quarter of a century, have been unable to prove it, or, if so, to get our colleagues to agree with our evidence.

There is, however, a central sarcoma. In my experience, it has always been, with the exception of the bone aneurysm, either a myxo- or a chondro-sarcoma, and so far, all of these cases have succumbed to metastasis to the lungs.

There also seem to be a few examples of the so-called *bone aneurysm* which, in the gross is a hemorrhagic cyst. The majority of these are giant-cell tumors. But in a few the tumor tissue within the bone shell lining the blood cavity has the microscopic appearance of a very cellular sarcoma. Usually giant cells are absent, and these patients die of metastasis. Some observers might call these giant-cell tumors.

The majority of metastatic tumors in the very beginning have a roentgen picture almost identical with the central giant-cell tumor, bone cyst, chondroma or myxoma. Again and again I have seen metastatic carcinoma in bone involving the entire skeleton appear with roentgen shadows apparently identical with the multiple bone cysts.

The same is true of multiple myeloma. In metastatic bone tumors which, with the rarest exceptions are carcinoma, there is usually a characteristic roentgen picture. The central shadow is never clear cut, as in the bone cyst, giant-cell tumor, myxoma and chondroma, because in these latter primary central lesions there is never any remains of bone, except in the shell, while in metastatic tumors there is often a *mixture of tumor tissue and old and*

new bone. Again, the inner surface of the bone shell in the primary tumor is usually smooth, because the bone has been destroyed uniformly by the pressure of the primary central growth, while in the metastatic the bone shell is often irregular, due to the fact that the infiltrating metastatic tumor tissue produces both bone formation and bone destruction. Again, in the metastatic bone lesion, there is often a reaction on the part of the periosteum, with bone formation.

When the single metastatic bone lesion has the appearance of the ordinary bone cyst or giant-cell tumor and there are no other data, it is very difficult, and often impossible, to make a differential diagnosis. On the other hand, when the irregularity of the bone formation and bone destruction gives rise to the mottling and irregularity of the central shadow and irregularities in the bone shell and new bone formation on the periosteal side, it cannot be differentiated from the periosteal group, sarcoma, or the different types of periostitis and osteomyelitis.

This statement as the description of the roentgen appearance in central lesions is based on a re-study of the films and lantern slides in almost 400 cases.

When the roentgen examination shows a distinct central lesion and it involves the epiphysis, the chances are that it is not a bone cyst. In less than 10 per cent of the cases of ostitis fibrosa is the epiphysis involved, and in less than 2 per cent of the giant-cell tumors is the shaft involved. Myxoma, chondroma and myxo- and chondro-sarcoma may involve either shaft or epiphysis—there is no way of differentiating. Age is somewhat helpful. If the patient is under fifteen, the central lesion should be a bone cyst. If it involves the shaft, with the rarest exceptions, it is a bone cyst. If it involves the epiphysis it is usually the giant-cell tumor. Chondroma and myxoma and chondro- and myxo-sarcoma usually are in individuals over eighteen years of age, most frequently over thirty-five.

The method of attack in central tumors was described in Minnesota Medicine 1922, V, 604–610.

JOSEPH C. BLOODGOOD.

NORMAL BONES AND JOINTS

The latest addition to the Series of Monographic Atlases, Annals of Roentgenology, edited by James T. Case is Volume Four on Normal Bones and Joints by Isidore Cohn. A comprehensive review of the work will be published in a subsequent issue of the Journal. Our purpose at present is to call attention to the Foreword by Rudolph Matas, which is an appreciation of the part played by roentgenology in medicine and surgery and a historical sketch of the application of the roentgen ray to the development of knowledge of the anatomy and pathology of bones and joints. Its style and subject matter combine to make it interesting reading, as is shown by the following quotation from the opening paragraphs:

"The recent death of Wilhelm Konrad Roentgen on February 10, 1923, has roused the scientific, especially the medical, world, to a sense of the immense debt that it owes to his genius. Some of his biographers and others interested in recording the progress of science have attempted to survey the vast domain that he first discovered and explored. The German Roentgenological Society in 1914, compiled a catalogue of 15,000 titles embracing the roentgenological literature that had appeared up to that time, and yet this index was incomplete as it registered only contributions that pertained strictly to roentgenology. Of a large number of clinical and other professional as well as non-professional papers in which roentgen rays were indirectly concerned, this index took no account. Bibliographic compilations of this character may afford some estimate of the gigantic volume of literature which has sprung up as if by magic from the seed sown at Würzburg a little over a quarter of a century ago (December 28, 1895). But no bibliographic index, no matter how voluminous, can exhibit in its fullest light the incalculable influence that Roentgen's portentous discovery has exercised upon the progress of the pure, as well as the applied, sciences, of which the healing science and art have had the most direct and immediate benefit. Roentgen's demonstration of the penetrating powers of the *x*-rays startled the world with its immense

practical possibilities and the application of the new light to the problems of medicine and allied biologic sciences obscured and overshadowed the effect that its interpretation has had upon the progress of the physical and chemical sciences as an initial step in the historical evolution of radioactivity and as the foundation of the new science of radiology.

"Roentgen rays, through the mystery that surrounded their origin and mode of production, spurred the finest brains of the century to new efforts and to marvelous accomplishments. These, following in rapid succession, have built a new foundation in speculative philosophy which has culminated in a radical reconstruction of the older concepts of the atom, and, in this way, illuminated the very essence of primordial matter itself."

The roentgenologist must feel a thrill of pride and at the same time the weight of responsibility that is upon him when he reads as follows:

"The roentgenologist is today, next to the surgeon, the foremost exponent of the anatomy, physiology and pathology of the living organism, which so profoundly differentiates the practice of medicine of the present from that of the past. With the fluoroscopic screen the roentgenologist visualizes, and with the roentgenogram he records and enlarges upon what he sees. Almost with every flash of his radiant tube, he performs a biopsy, a painless vivisection, which penetrates further than any dissection and, by what it reveals, often prevents a necropsy.

"The roentgenologist, if he is to exercise his functions properly, must be prepared to collaborate with the internist and the surgeon in every one of their several specialized departments. As an interpreter of bone-shadow records he aids the pediatrician and the orthopedist in the diagnosis, prognosis and treatment of the disorders of nutrition, metabolism and those caused by endocrine disturbances, vitamine deficiency, toxemias and infections which attack the osseous framework and interfere with normal skeletal growth. In the same way he is the right hand of the surgeon in differentiating fractures from epiphyseal separations and simple contusions or sprains, a matter of no small importance in deciding the prognosis and treatment of such injuries. His indispensable relation to the dental surgeon in the diagnosis of the developmental errors of dentition, need only be mentioned to be appreciated. Therefore, apart from all the other daily and hourly applications of roentgenology to the routine of medical practice, a knowledge of normal developmental osteogenesis is an obligate function of the roentgenologist if he be worthy of the role of collaborator in medicine, or claims a title beyond that of mere technician. From this special, as well as from the more general medicochirurgical point of view, it would appear that the time is ripe for a systematic and comprehensive treatise and an atlas on roentgenologic developmental osteology, planned on the lines above suggested. It is also true that the textbooks on anatomy now current in this country and abroad should revise the data on the chronological development of the skeleton in the light of modern roentgenological research. The discrepancies between the old and the new methods of investigation should be adjusted and the usually dry and unattractive mode of presenting this subject should be changed to fit the practical importance at present attached to a knowledge of developmental osteogenesis."

Subscribers to THE AMERICAN JOURNAL OF ROENTGENOLOGY AND RADIUM THERAPY *visiting New York City, are invited to make the office of* THE JOURNAL *(69 East 59th Street, New York) their headquarters. Mail, packages or bundles may be addressed in our care. Hotel reservations will gladly be made for those advising us in advance; kindly notify us in detail as to requirements and prices. List of operations in New York hospitals on file in our office daily.*

SOCIETY PROCEEDINGS, CORRESPONDENCE AND NEWS ITEMS

Items for this column solicited promptly after the events to which they refer.

JOINT MEETING OF WESTERN SECTION, AMERICAN ROENTGEN RAY SOCIETY, AND THE PACIFIC COAST ROENTGEN SOCIETY

The annual meeting of these two societies was held jointly in Seattle and at Mt. Ranier National Park, July 21–24, 1924.

The meeting was a most enjoyable and helpful one. The ideas of the Seattle members, led by Dr. H. B. Thompson, of holding an open session in Seattle to which the general profession was invited and of then retiring to another locality for the meeting of the roentgenologists, was excellently worked out and proved in practice to be of value.

A combination of work sessions in the evening and vacation trips in the daytime proved an admirable plan. Those making the journey were fully repaid from the enjoyment side as well as from the educational value of the program.

The Western Section of the American Roentgen Ray Society elected Dr. H. B. Thompson of Seattle, Chairman, and Dr. Irving Ingber of San Francisco, Secretary.

The Pacific Coast Roentgen Ray Society elected the following officers:

President: Dr. R. A. Payne, Portland, Oregon.

Vice-President: Dr. Wm. E. Chamberlain, San Francisco, Cal.

Secretary: Dr. Roscoe G. Van Nuys. San Francisco, Cal.

SECTION ON RADIOLOGY

SOUTHERN MEDICAL ASSOCIATION

THE SOUTHERN MEDICAL ASSOCIATION MEETS AT NEW ORLEANS, NOV. 24–27, 1924

General Headquarters-Roosevelt Hotel, formerly the Grunewald. Reservations may be made with the Chairman of the Committee on Hotels, Dr. J. C. Menendez, P.O. Box 1460, New Orleans, La.

The Radiological Section will hold two half-day scientific sessions, Monday and Tuesday, November 24th and 25th, at 2 P.M.

The program has been so arranged that all the territory covered by the Association will be represented. It will be published in detail in the Southern Medical Journal.

The Sections on Surgery and Radiology will give a joint dinner on Tuesday or Wednesday evening. Dr. Hugh Cabot and Dr. Preston Hickey, both of the University of Michigan, Ann Arbor, will be the guests of honor. Dr. Cabot, representing the Section on Surgery, will present an address on "Malignant Diseases of the Kidney;" Dr. Hickey will represent the Section on Radiology, the title of his presentation being "Malignant Diseases of the Kidney from the X-ray Standpoint."

In addition there will be clinics held by the various other sections which may be of interest to the roentgenologists.

Those attending the meetings, who are interested in radiology, are extended a cordial invitation to participate in the scientific session of the Section on Radiology.

W. R. Bethea, Chairman,
Memphis, Tennessee.
E. C. Samuel, Vice-Chairman,
New Orleans, Louisiana.
H. E. Ashbury, Secretary,
Baltimore, Maryland.

FAREWELL DINNER TO PROFESSOR FORSSELL

On the evening of September twenty-sixth the New York Roentgen Society gave a farewell dinner to Professor Forssell of Stockholm, at the Commodore Hotel in New York City. Dr. Dixon, President of the New York Roentgen Society presided and Dr. Thomas A. Groover of Washington, President-Elect of the American Roentgen Ray Society, introduced Dr. Forssell.

Dr. Forssell addressed the meeting on the subject "The Mechanism of Movement of the Mucous Membrane of the Digestive Tract." The address was an elaboration and continuation of a paper published in the Journal in February, 1923 (Vol. X, page 87). He presented additional evidence in support of his view that the folds of the mucous membrane of the stomach are produced, not by a passive folding due to contraction of the *muscularis propria*, but are formed by contraction of the *muscularis mucosa* itself. He illustrated the address by many excellent slides of photographs of pathological specimens and of roentgenograms. It was altogether an exceedingly interesting and convincing demonstration.

The entire visit of Dr. Forssell to this country has been greatly appreciated by American roentgenologists. The presentation of his scientific work has been rendered doubly effective by his attractive personality and fine command of the English language. Our good wishes return with him to his own country where many of us hope to meet him again next year after the International Meeting of Radiologists in London.

A NEW CHAIR AT JEFFERSON MEDICAL COLLEGE

In recognition of the far reaching developments of bronchoscopy in the diag-nosis and treatment of diseases of the lungs and of esophagoscopy and gastroscopy in the diagnosis and treatment of diseases of the esophagus and stomach, the Board of Trustees and Faculty of The Jefferson Medical College have created a new Chair to be known as the Department of Bronchoscopy and Esophagoscopy. Dr. Chevalier Jackson, formerly Professor of Laryngology in The Jefferson, has been elected to the Professorship of the new Department. Dr. Fielding O. Lewis has been elected to fill the Chair of Laryngology vacated by Dr. Jackson.

DEPARTMENT OF TECHNIQUE

Department Editor: DAVID R. BOWEN, M.D., Pennsylvania Hospital, Philadelphia, Pa.

In this department will be published from time to time, as material is available, suggestions for improvement in technique.

FILM MARKING BY A NEW METHOD

BY ROBERT B. TAFT, M.D.

ROENTGENOLOGICAL INTERNE, BELLEVUE HOSPITAL
NEW YORK CITY

THE accompanying film (Fig. 1) has been marked by a new method which seems to be satisfactory. The desirability of marking the patient's name and other information on the film at the time of the exposure has long been recognized but the trouble and time involved in the arrangement of, as well as the space occupied by lead letters, stencils, or tin foil stampings has contraindicated their use.

The method is as follows: About 25 per cent of standard mucilage acaciae is added to ordinary writing ink. By means of a heavy stub pen, this mixture is used for writing the desired information on a slip of paper. Before the ink has had time to dry, powdered metallic lead (fine filings) is sprinkled on and the excess shaken off, which leaves a thick ribbon of lead enmeshed in the form of the writing. The piece of paper is next put alongside the part that is being roentgenographed and the exposure made in the usual manner, the lead-writing simply taking the place of the ordinary block-lead numbers.

FIG. 1. Shows film marked by the method described.

Finely powdered metallic lead can be obtained from any chemical supply house. The only precaution necessary is that the writing be heavy and on a good grade of non-absorbing paper. The lead is most conveniently kept in a small cardboard box, a little piece of cardboard being used to scoop it up and pour it generously on the writing (Fig. 2) after which the excess is put back in the box. Markers that are used many times such as the name of the hospital, "right," "prone," etc., are best preserved by placing them between layers of adhesive plaster.

FIG. 2. Shows method of placing lead filings on writing.

On first consideration one would think that a dense writing fluid could be obtained even more easily than this but when cognizance is taken of the fact that all the salts of the very heavy metals are, for practical purposes, insoluble, the problem becomes much more difficult. Experiments with the saturated solutions of salts as sodium bromide, silver nitrate and mercuric chloride showed them to be entirely too light. An attempt was made to obviate this difficulty by suspending some of the heavy insoluble substances such as barium sul-

phate, mercuric iodide and lead oxide in a mucilage. However these mucilages would not flow from a pen and even when painted on with a brush would show only on soft exposures. Even a saturated solution of a heavy salt in which was suspended a heavy insoluble substance proved to be inadequate. An attempt was made to incorporate some of these materials in a wax crayon, but the friability of such a mixture made it wholly unfit for writing. Such bases as are used in the manufacture of aluminum paint proved unsatisfactory for holding any quantity of lead and at the same time flowing from a pen.

It would seem therefore, that it is chemically and physically impossible to make a writing fluid that is opaque to the passage of hard rays, but the difficulty is circumvented by putting the lead into the fluid after the writing has been done.

In conclusion, the method of sprinkling powdered lead into the acacia-ink script seems to be a simple, neat, and satisfactory way of marking the patient's name on the film at the time of exposure.

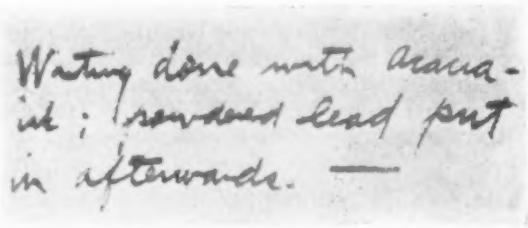

FIG. 3.

NOTE. This method seems especially applicable when, for medicolegal cases it is desired to have the operator's signature on the film. D. R. B.

BOOK REVIEWS

Books Received Are Acknowledged under Heading: Books Received. This must be regarded as a sufficient return for the courtesy of the sender. Selections will be made for review in the interests of our readers and as space permits.

THE PREVENTION OF DENTAL CARIES AND ORAL SEPSIS. By H. P. Pickerill, C.B.E., M.D., Professor of Dentistry and Dean of the Dental School in the University of Otago. Third edition. Cloth. Price, $6.00. Pp. 340, with 80 illustrations. New York: Paul B. Hoeber, Inc., 1924.

The author introduces his subject with a chapter on the history of preventive dentistry, in which he compares the teachings of the nineteenth and twentieth centuries with those of the fifteenth, and shows that they are almost identical. Since the incidence of dental caries has increased very rapidly in the last five hundred years, it would seem obvious that the treatment is radically wrong.

A considerable portion of the work is devoted to what the author terms "the forces of natural protection," among which he names the saliva and the physical properties and powers of resistance of the enamel surface.

The author makes a strong argument for a change of treatment, and concludes his work with a discussion of educational measures and a plea for special legislation.

The book is well worth the study of students and practitioners of dentistry, and would be instructive to medical practitioners, primary school teachers, and in fact to any one interested in the health of the mouth and teeth.

L. M. CHRISTIE.

A SYSTEM OF SURGERY. Edited by C. C. Choyce. Three Volumes. Cloth. $35.00. 1013 pp., 1176 pp., 1057 pp., Second edition. New York. Paul B. Hoeber, Inc. 1923.

The names of the authors collaborating in the production of this system of surgery is sufficient to insure a work of the highest order. When Mr. Choyce selected such men as Professor Beattie, Sir Thomson-Walker, Messieurs Bonney, Handley, Sherren, and Trotter, he had accomplished much toward producing a valuable work.

In volume one the principles of surgery are thoroughly covered in the chapters on surgical bacteriology and its therapeutic applications, inflammation and its treatment, repair, suppuration, ulceration, gangrene, wounds and wound treatment, burns and scalds, constitutional disturbances associated with trauma, toxaemia, septicemia, pyemias, and tumors. The remainder of this volume and volumes two, and three, are devoted to the principal surgical diseases and the surgery of all the regions and most important organs of the body, and further, to the surgery of the muscles, fascia and tendons, bursae, diseases of bones, fractures, the joints, and concluding the work there is a special chapter on orthpoedic surgery.

Rather than attempt a detailed review of each chapter, which could not be done adequately in a short review, I prefer to emphasize those chapters which I believe to be most important.

The chapter, The Breast, by W. Sampson Handley, is most complete and instructive, and the splendid illustrations, composed of photographs, drawings, and photomicrographs, decidedly enhance its instructive features.

The Stomach and Duodenum, by James Sherren, with its selected bibliography is most noteworthy. Beginning with a short review of the anatomy and physiology of the stomach and duodenum, he then discusses clinical examinations, physical examinations, and the special methods of examination in a thorough, but not lengthy manner. The anomalies and diseases of the stomach and duodenum with their treatment is well considered and supplemented with adequate illustrations. Altogether, the article with its bibliography, is a comprehensive resumé of a most important subject. Immediately following this article are the chapters on the intestines, appendix, and peritoneum, which are equally deserving of favorable comment.

The Upper and Lower Urinary Tract, by Sir John Thomson-Walker, by first considering the anatomy and physiology of the urinary system, follows a general outline of the other chapters of this work. The kidney, ureter, bladder, and urethra are each considered separately as to anomalies, diseases, stone formation and enlodgement, fistula, stricture, and tumors. The illustrations, while few in number, are among the finest of this publication.

Wilfred Trotter has an excellent chapter on the scalp, skull, and brain, and one on the spine and spinal cord, in collaboration with Gwynne Williams. The subjects have been carefully prepared. The result appears to be the work of one experienced and thoroughly familiar with the subject. The description of head injuries including concussion, contusion, and laceration of the brain, and that of extradural and intracranial hemorrhage, and fractures of the skull is very clear and enlightening in addition to being most interestingly written.

The chapter on general anesthesia by Dr. J. Bloomfield would have to be re-written to conform to the views held by American surgeons and anesthetists. For the *inexpert administrator* he states, "there is nothing better than the mixture of chloroform and ether, known as the C. E. mixture." For a more *expert administrator* he states, "nitrous oxide with oxygen, or air, is the safest anesthetic." I would reverse this order. The C. E. mixture has never been popular in America and is rarely, if ever, used. This contributor also discusses the use of ethyl chloride and chloroform for general anesthesia. These two substances are considered by American surgeons to be too dangerous to be used, and for this reason have been abandoned. The nitrous oxide-oxygen-ether sequence, as used in America, and so popular because of its safety and satisfaction, is not given sufficient emphasis. The article on local anesthesia by Williams and Rood must be criticised for its brevity. Considering the wide application of local anesthesia today the chapter is entirely too brief. It should include more detail as to technique and apparatus, and diagrams to show the points to be injected for regional nerve blocking and areas for local infiltration for the commoner operations done under local anesthesia, such as herniotomy, enterostomy, etc.

The chapters on diseases of bones and the joints, by the Editor, C. C. Choyce, fill an important place in his system of surgery. The chapter on diseases of bones is very well and concisely presented for a subject of such importance. The one on the joints treats fully this too often neglected topic.

Any review of this system of surgery would not be complete without a well merited commendation of the chapter on surgical bacteriology, inflammation, suppuration, gangrene, wounds and wound treatment, tumors, acquired syphilis, congenital syphilis, malformation of the face, lips, and palate, the rectum and anal canal, the female genital tract, fractures, and injuries and diseases of the nerves.

Choyce has successfully produced a system of surgery that will be a valuable textbook and reference work for the student and surgeon. All the branches of surgery are covered in a concise manner, yet none of the essentials are omitted. For the production of such a work Choyce deserves much praise. One is impressed by the descriptions and illustrations of surgical pathology and to make the review complete much credit must be given to the Co-editor, Professor Beattie, who has edited so well the parts of this publication.

EDMUND HORGAN, M.D., F.A.C.S.

GROEDE. F M., *Lehrbuch und Atlas der Röntgendiagnostik in der inneren Medizin und ihren Grenzgebieten.* (Textbook and Atlas of Roentgen Diagnosis in Internal Medicine and its Branches.) Fourth, completely revised and considerably enlarged edition. With 712 illustrations upon 179 halftone plates and with 720 text figures. Two volumes. Munich, 1924. Published by J. F. Lehmann. 56 marks, bound.

This work, known to the clinician as well as to the roentgenologist, shows its worth and popularity in the fact that a new edition has again become necessary within a year. In it, the contributions of roentgenology to internal medicine are presented by 15 authorities. Thorough treatment is given of the following general subjects: Thorax, by Groedel, Jamin, Dietlen, Krause and Brauer; Heart by Groedel; Vessels by Krause; Stomach-Intestines by Groedel; the operatively altered digestive tract, by Götze; Uropoietic System by Haenisch; Skeleton by Köhler. Description is given of a complete and modern roentgen technique; and we also find treatment of related branches, such as Roentgen Diagnosis in Opthalmology by Schnaudigel, of the auditory apparatus, by Pfeiffer, of the jaws and teeth by Loos, of the upper respiratory passage by Spiess and Pfeiffer, and of the brain and cord by Otten.

Each section treats first of the normal roentgen anatomy and physiology, and then of the roentgen pathology, always with regard to the results of recent researches, and, in part, with considerable enlargements of former discussions. The extensive references to the literature given at the end of each chapter are valuable. The mention of the historical development of roentgen diagnosis is interesting and instructive, and at the same time discloses how the life-work of many still active roentgenologists has contributed to the general growth of the science. As a result of the rapid progress made, new chapters have become necessary. Thus, Groedel has written one on the human constitution in the roentgen picture, Dietlen on the "pathological lung picture," Götze on the differential diagnosis with aid of pneumoperitoneum, and Jamin a section on roentgen examination in pediatrics. The chapters on the esophagus, pancreas, liver and gall-bladder, and on the spleen were taken over by Lossen and thoroughly revised.

The external appearance of the work is greatly improved, the rather unwieldy volume of the 3d edition being replaced by 2 volumes. By a process tested by Groedel, the technical reproduction of the plates has been very satisfactory, and has replaced the expensive photographic process as far as possible. The plate

reproductions show depth and are clear and differentiated; and they have been increased by 170 illustrations. This work is a guide and an aid to the expert and to the practitioner. It is stimulating and itself typifies the statement of Groedel: "Being a roentgenologist means being an investigator."

G. F. HAENISCH.

BOOKS RECEIVED

A DESCRIPTIVE ATLAS OF RADIOGRAPHS OF THE BONES AND JOINTS. By A. P. Bertwistle, M.B., CH. B. Leeds, Resident Surgical Officer, General Infirmary, at Leeds. Cloth. Price, $5.00. Pp. 198, with 299 illustrations. New York: William Wood & Company, 1924.

FOIBLES AND FALLACIES OF SCIENCE. By Daniel W. Hering, C. E., PH.D., LL.D., Professor Emeritus of Physics and formerly Dean of the Faculty of the Graduate School in New York University. Cloth. Price, $2.50. Pp. 294. New York: D. van Nostrand Co., 1924.

MIND AND MEDICINE. By Thomas W. Salmon, M.D., Professor of Psychiatry in Columbia University. Pp. 32. New York: Columbia University Press, 1924.

BULLETIN NO. X OF THE INTERNATIONAL ASSOCIATION OF MEDICAL MUSEUMS AND JOURNAL OF TECHNICAL METHODS. Managing Editors: Maude E. Abbott, M.D., and Major James F. Coupal. Pp. 165. New York: Paul B. Hoeber, Inc., April 15, 1924.

INTERNATIONAL ABSTRACTS OF ROENTGEN AND RADIUM LITERATURE

WIENER, H. The effect of ultraviolet radiation on human protein and purine metabolism. *Klin. Wchnschr.*, May 20, 1924, iii, 936–937.

The metabolism experiments on man were conducted for extended periods, using for illumination a special carbon arc delivering an almost continuous spectrum between 400 and 290 $\mu\mu$. This lamp did not produce visible skin injury even after long exposures. In the first experiment, the irradiation lasted 30 to 80 minutes, and in the second, 70 to 100 minutes. Nitrogen, total phosphorus, total sulfur, uric acid and purine bases were determined daily in urine and feces.

Both experiments showed a distinct drop in total nitrogen excretion on the first day, returning to normal level on the second day, and decreasing again progressively with continued irradiations. There was a positive nitrogen balance which continued after cessation of radiations. The sulfuric acid excretion showed no changes, but the phosphorus excretion showed a distinct reduction proportional to the duration of irradiation. These observations indicate a retention of protein substances as a result of exposure. Temporary excess purine excretion occurs after irradiation, and this is believed to be merely the washing out of endogenous material stored in the tissues. These observations were made in connection with absence of erythema or pigmentation of the skin, and therefore point to the causal independence of skin reaction and general metabolism.

WOLMERSHÄUSER, O. The behavior of blood pressure and leucocytes during roentgen irradiation and their relations to the vegetative nervous system. *Strahlentherapie*, 1924, xvi, 235–244.

Blood pressure determinations were made in 90 patients after irradiation; among these, were 30 carcinomas and 9 spleen stimulation irradiations, the remainder being castration irradiations. The duration of exposure was from a few minutes up to 6 hours. In 75 per cent of the cases there was a distinct depression of blood pressure following irradiation. The drop in the blood pressure curve was gradual and steady, and the depression lasted several days and in some cases, weeks. The 4 cases which reacted by an increased blood pressure presented unusual clinical symptoms (vomiting, large myoma, psychoneurosis). Among the patients receiving the spleen stimulation irradiation, 4 responded with blood pressure drop as a result of the brief exposure. Simultaneous observation of the blood pressure, pulse and blood picture in patients irradiated for carcinoma almost always showed an inverse relation between the number of white blood cells and the blood pressure. There is one cause for these two facts and that is believed to be a vagus action induced by blood vessel paralysis in the skin as a result of roentgen-ray action. The latter causes stasis in the dilated vessels and is recognizable by the increasing leucocytosis and the depression of blood pressure. Great caution is therefore necessary in a critical judgment of the blood picture following roentgen irradiation. Pilocarpin action has been shown experimentally to give a similar relation of blood pressure and leucocyte count; and similar reflex processes are also often observed to follow irradiations. The almost instantaneous elimination of oliguria after irradiations of large myomas, the prompt analgesic effects and the favorable action on gastric ulcers are all due to this reflex. Moreover, roentgen catarrh shows striking similarity to the pilocarpin action.

ANCEL, P., AND VINTEMBERGER, P. The stimulating action of roentgen rays upon embryonal development. Compt. rend. Soc. de biol., Par., July 25, 1924, xci, 606–609.

The egg of the hen is poor material for determining the effect of roentgen rays upon development. Of the large numbers treated with rays some developed more rapidly than the controls, some showed delayed development, while others gave no evidence of any effect whatever. In any case, the variations were within the limits of experimental error.

With the eggs of *Rana fusca*, artificially fertilized, the experiment can be controlled with exactness. Treatment of 590 eggs, in various stages of development, and for variable lengths of exposure to the rays, failed in every case to show an acceleration of development. Any deviation from normal development consisted in a retardation.

ARRILLAGA, F. C., AND IZZO, B. A. Acute adrenal insufficiency caused by irradiation of a tumor in a patient with Addison's disease. Compt. rend, Soc. de. biol., Par., June 13, 1924, xci, 27.

A patient with Addison's disease received irradiation for an epithelioma. The treatment lasted for 42 min.—200,000 v., 4 ma., focal distance 30 cm., focal field 9 × 12, filtered through 0.5 mm. of copper and 1 mm. of aluminum. On the following day there was

extreme excitement and the patient had to be forcibly held in bed. The temperature rose to 38.5° and 24 hrs. later the patient fell into coma. An injection of 0.001 g. of adrenalin relieved the condition and the patient continued well as long as the specific therapy continued. When the administration of the adrenalin was discountinued coma again appeared. Renewed treatment improved the condition but the patient later died. It is assumed that the irradiation caused adrenal insufficiency.

BENOIT, JACQUES. The action of roentgen rays upon the testicle of the rooster. Compt. rend. Soc. de biol., Par., Mar. 28, 1924, xc, 802–805.

Treatment of the animal with roentgen rays, leading to a complete and permanent disappearance of the seminal cells, does not interfere with the development of the crest, indicating that the hormone responsible for this secondary sexual character must be derived from the interstitial cells or the cells of Sertoli.

CANUYT, G., AND WOLF, M. The effect of irradiation of different portions of the body upon nasal hemorrhages. Compt. rend. Soc. de biol., Par., July 25, 1924, xci, 611–612.

Patients with so-called essential hemorrhages were treated by irradiation of different portions of the body—hands, neck, face, etc. Three exposures of ½ to 1 hour each at 1 to 3 day intervals were given. The results were very striking. One patient who had suffered from nose-bleed almost daily for 3 years remained free for a period of 3 months; another who had had continuous bleeding for 8 days was relieved by a single treatment. Not all cases respond to the treatment. Studies on blood coagulation made in conjunction with the therapy showed in some cases a reduction of 50 per cent in the coagulation time.

DE COULON, A. The action of different radiations of the visible spectrum upon an epithelial tumor of the mouse. Interpretation of the results. Compt. rend. Soc. de biol., Par., Feb. 22, 1924, xc, 448–450.

The results here reported closely correspond with those previously reported, and an analysis of the whole series of experiments leads to the following conclusion, namely, that the spectrum is divided into zones which, alternately, exert a stimulating and an inhibitory effect upon the development of sarcoma (and epithelial tumor) in the mouse.

DE COULON, A. The action of different radiations of the visible spectrum upon sarcoma grafts in mice. Compt. rend. Soc. de biol., Par., Feb. 22, 1924, xc, 445–448.

Mice with implanted tumor grafts were placed in cages so arranged that the only light penetrating the cages passed through selected filters. The filters were adjusted to divide the spectrum into four zones, λ720–620, λ625–590, λ575–490 and λ475–410, and the animals in each of four cages received radiations of the types indicated. Twelve days after the beginning of the experiment, examination showed that the grafts were positive in all cases. Subsequent examination showed that of the animals in the first cage (λ720–620) a regression of the tumors took place in 40 per cent; of those in cage II (λ625–590) in 100 per cent; in cage III in none; in cage IV (λ475–410) in 33 per cent. From this, in conjunction with a series of comparable experiments it is concluded that the regions located at about λ650, and at λ550, and beyond λ500 coincide with an activation of the growth of the grafts, as compared with the control animals, while the regions at about λ600 and at 525 correlate with an inhibition in the development of the tumors.

DOGNON, A. Effect of wave length upon the flocculation of a colloidal solution by roentgen rays. Compt. rend. Soc. de biol., Par., June 27, 1924, xci, 197–199.

The difference in the rate of flocculation of mastic solutions by wave lengths of different types is small. Furthermore, the effects as observed upon solutions of mastic do not necessarily indicate the nature of the effects to be obtained in strictly biological systems.

GOSSET, A., GUTMANN, A., LAKHOVSKY, G., AND MAGROU, J. Therapeutic experiments in "experimental cancer of plants." Compt. rend. Soc. de biol., Par., Aug. 12, 1924, xci, 626–628.

By the inoculation of *Pelargonium zonatum* with *Bact. tumefaciens* actively growing tumors can readily be produced, and the therapeutic experiments consisted in exposing these tumors to irradiation with the Radio-Cellulo-Oscillator of Lakhovsky. Repeated daily treatments were given, each lasting about 3 hours. During the days following the first treatments the tumors continued to grow actively, forming, like the controls, large multilobular masses. With continued treatment, however, the tumors presented evidences of necrosis (after 16 days) and eventually the necrosis became complete, with retraction of the lobes and desiccation of the mass. They could readily be detached from the plant. The necrotizing action was strictly elective, none of the normal tissues of the plants showing injury.

JOLLY, J. Comparative sensitivity of different lymphoid organs to roentgen rays. Compt. rend. Soc. de biol., Par., July 11, 1924, xci, 354–356.

Comparative studies were made of the lesions induced in the femoral marrow and the popliteal ganglion in rabbits subjected to treatment with roentgen rays for variable lengths of time. Lesions appear in the ganglion much earlier than in the marrow. Within two to six hours after the exposure the ganglion presents evidences of an intense reaction while the marrow as yet presents no change. A reaction in the latter tissue does not appear until after about 12 hours, at a time when the ganglion has already commenced to eliminate the products of destruction. Recovery in the marrow does not begin until the fifth day and the processes of regeneration may continue up to the twenty-first day. Regeneration of the ganglion is accomplished by the eighth day.

JOLLY, J. The effect of roentgen rays upon cells. Diminution in the reactivity of a sensitive organ by ligation of the afferent arteries. Compt. rend Soc. de biol., Par., July 25, 1924, xci, 532–534.

Rabbits in which one iliac had been ligated were exposed to roentgen rays. A few hours after the treatment the animal was killed and histologic preparations were made of the popliteal ganglia. The tissues from the leg with intact circulation showed the characteristic lesions, while the lesions of the tissue from the ligated leg were less marked. Apparently radiosensitivity is not solely a function of the type of cell, but also of the physiological condition of the cells.

JOLLY, J. The effect of roentgen rays upon cells. Modifications in the radiosensitivity by ligation of the vascular connections. Compt. rend. Soc. de biol., Par., July 11, 1924, xci, 351–354.

Among the tissues very susceptible to the action of roentgen rays is the thymus, and because of the anatomical relationships of this organ as found in the guinea pig it lends itself very readily to experimentation. The two lobes of the organ are distinct and are superficial, so that by a very simple operative procedure either or both of the lobes can be exposed. The experiment here described consisted in exposing both lobes and isolating one of them from the circulation by means of ligature. After closing the skin the whole neck region was subjected to an intense irradiation. The animal was sacrificed two or three hours after the treatment, both lobes were removed and specimens were prepared for histologic examination. The lobe which had been cut off from the circulation showed no lesions whatever, while the other, treated with the circulation intact, gave evidence of very extensive damage, particularly in the cortical substance. A similar experiment performed upon the rat with the circulation of one portion of the spleen cut off gave comparable results.

The most natural explanation, that a toxic substance is elaborated in the circulation, is inadequate to explain all of the findings. It appears more probable that the results are due to an abrupt diminution in the vitality of the cells brought about by interruption of the circulatory system. Like the nervous cell, or the sensory cell, the radiosensitive cell apparently needs its full vitality and nutritional processes in order to effect a reaction to the stimulus. Radiosensitivity is a property of the cell depending upon the normal functioning of the cell and upon the integrity of its typical metabolic exchanges. The cell does not undergo irradition in a purely passive manner. It reacts, and any abnormal circumstance which prevents reaction protects the cell, rather than rendering it more susceptible. With the circulation impaired the cell is, in effect, in a state of asphyxia, and the life processes are suspended.

LACASSAGNE, ANTOINE, AND LATTÈS, JEANNE. Distribution of polonium, subcutaneously injected, throughout the tissues of rats bearing implanted cancerous tissues. Compt. rend. Soc. de biol., Par., Feb. 15, 1924, xc, 352–353.

Rats were injected subcutaneously with large doses of polonium (150 to 200 electrostatic units) after they had received implantations of fibrosarcoma or adenosarcoma. The radioactivity of the tissues of the rats, determined at various intervals, was compared with the amount of polonium found in the same tissues by electrometric titrations following chemical extraction. Roentgenographic determinations revealed the polonium distributed evenly throughout the living portions of the tumors, but in the centers of the tumor masses where evidences of necrosis could be detected the amount of polonium appeared to be materially less. This difference is apparently associated with an impairment of the circulation. In all cases the roentgenographic values for the implanted tumor tissues were much less than the values for the organs of the animal, particularly such organs as the kidney, spleen, and liver.

Chemical determinations, made on the tissues taken from the animals seven days after the injection, correlated perfectly with the roentgenographic determinations. The

highest concentration of polonium was found in the spleen. The liver contained only about one-eighth as much as the spleen, but as regards radioactivity the liver was eleven times as active as was the tumor tissue. There is no evidence that cancerous tissues possess any especial affinity for polonium.

LACASSAGNE, ANTOINE, AND LATTÈS, JEANNE. Special histological localizations of polonium within certain organs. Compt. rend. Soc. de. biol., Par., Feb. 29, 1924, xc, 485–487.

Comparison of the auto-roentgenograms of the organs of animals injected with polonium with photographs of histological preparations gives added information regarding the fixation of the radioactive substance in the tissues. The tissues described are those of the rabbit. The roentgenograms show large amounts of polonium, particularly in the cortex of the kidney. The tubuli contorti are sharply outlined; the blood vessels and the glomeruli, containing none of the element, cannot be seen. The fetal placenta shows a marked localization, the maternal placenta but little polonium. The roentgenograms show large amounts in the liver. The pulmonary epithelium is also a point of localization. Ovary and adrenal contain but little.

LACASSAGNE, ANTOINE, AND LATTÉS, JEANNE. Histologic localization of polonium within the hematopoietic organs. Compt. rend. Soc. de. biol., Par., Feb. 29, 1924, xc., 487–489.

The cells of the phagocytic reticulo-endothelial apparatus fix polonium in large amounts. The fixation of the radioactive element in the hematopoietic organs causes an interference with the formation of the blood cells.

MURPHY, JAMES B., AND MAISIN, J. The similarity between the action of roentgen rays and that of tar. Compt. rend. Soc. de biol., Par., April 11, 1924, xc, 974–975.

The clinical and histological resemblances between the tissues of mice repeatedly irritated by the application of tar and those of animals subjected to radiation are very striking. With roentgen-ray treatment not only is there evidence of a local cutaneous reaction but there is at the same time a reduction in the general resistance of the animal to inoculation with cancer. Moreover, animals naturally immune or artificially immunized may be made susceptible by treatment with the rays. In a similar way tar, and some of its distillation products, induce local reactions. Experiment shows that tar treatment likewise increases susceptibility to inoculation, since in the animals receiving tar treatment the percentage of positive results was higher, the index of growth was greater, and the occurrence of visceral metastases was more frequent than in a comparable group of control mice. Mice naturally immune, or those artificially immunized, were treated with tar and subsequently inoculated with tumor. Clearly the tar treatment reduced the resistance, since in these mice positive grafts were readily obtained.

MURPHY, JAMES B., MAISIN, JOSEPH, AND STURNE, E. The mechanism of the action of roentgen rays on the development of spontaneous tumors in mice. Compt. rend. Soc. de biol., Par., April 11, 1924, xc, 972–974.

The apparent contradiction that cancer cells are very resistant to roentgen rays while radiation has a distinct therapeutic effect has never been satisfactorily explained. The experiments reported bear upon this problem, with the conclusion that tumor cells are no more sensitive to roentgen rays *in vivo* (or *in situ*) than they are *in vitro*. Tumors treated with rays *in situ* grow actively when removed from the unfavorable influences of the irradiated tissue and implanted in an untreated region of the same animal.

PAGNIEZ, PH., RAVINA, A., AND SOLOMON, I. Effect of the irradiation of different regions upon the coagulability of the blood. Compt. rend. Soc. de biol., Par., May 16, 1924, xc, 1227–1228.

The exposure of any region of the body to roentgen rays results in a decrease in the coagulation time of the blood. Obviously the effect is not exercised solely upon the glandular organs since the same changes in coagulability occurred when the tissues exposed were the palm of the hand. Furthermore, that the effect is produced upon the blood itself and not on the tissues appeared from the fact that when the circulation to the hand was cut off prior to the exposure no reduction in coagulation time took place. Only blood circulating *in vivo* shows this sensitivity, since *in vitro* no comparable effect is evidenced.

RUD, EINAR. Blood studies upon individuals working in radiologic institutes. Compt. rend. Soc. de biol., Par., Aug. 12, 1924, xci, 775–776.

The studies were made upon 18 persons who are employed in the Rigshospital and the Institute for Radium Therapy at Copenhagen. No evidence of a reduction in hemoglobin, erythrocyte count, or osmotic resistance of the red cells could be detected. The leucocyte counts gave average values for the men of

4,900 and for the women of 5,850. The lowest count observed was one of 2,800, noted in a technician who had been working for 10 years with roentgen rays.

SOKOLOFF, B., AND WECKOWSKI, C. Lymphocytosis and radium therapy of malignant tumors. Compt. rend. Soc. de biol., Par., Jan. 25, 1924, xc, 60–61.

In the treatment of cancer the use of large doses of radium leads, in certain cases, to a marked reduction in the lymphocytic index and in the erythrocyte count, and in this way lessens the resistance of the individual. Effects of this nature, exerted upon the lymphocytic system, explain the recurrences and the tendency toward generalized distribution noted in connection with intensive radium therapy.

BAENSCH, W. Pyelography. *Ergebn. d. Chir. u. Orthop., Berl.*, 1923, xvi, 755–799.

The pyelogram is a valuable adjuvant in the diagnosis of the so-called surgical diseases of the uropoietic system, and often will be valuable in determining the treatment. Technically, it is not very difficult if precaution is observed, and no more dangerous than other methods of diagnosis.

Contraindications are, old age, advanced arteriosclerosis, recent hemorrhage, purulent cystitis, and renal insufficiency with uremia.

Technique. Thorough purging two days before the pyelogram is taken, avoidance of narcotics, and skillful manipulation of instruments. Non-adherence to these will endanger the patient and yield false roentgenograms. The residual urine must be removed from the renal pelvis. For testing the renal pelvis, it is necessary to introduce the contrast medium from a buret at an optimum pressure of from 40 to 50 cm., but never higher (the contrast medium containing 25 per cent potassium bromid solution). Oxygen insufflation is suitable for small calculi of the renal pelvis, and may be used in combination with pneumoperitoneum. Roentgenograms should be made without compression under short exposure, and possibly without enforcing screen. Injuries are generally due to mechanical agencies, such as over-pressure due to injections with the record syringe, or to toxic action from using collargol, silver iodid (pyelon) or potassium iodid. Infection is very rare. Anomalies in the genito-urinary tract which exist in 5 per cent of all human beings are of great significance for operations.

In the very rare instance of renal aplasia, both ureters may terminate normally in the bladder. Normal renal axes may converge upward, and in horseshoe kidney, caudally. In this instance, the renal pelvis is located below and has short ureters.

In the diagnosis of hydronephrosis, the pyelogram is of little use, except in advanced cases where distortion of the renal pelvis is observed. Pneumoperitoneum is preferable for this diagnosis. Dilatation hydronephrosis may have a long period of latency. In one instance it appeared 27 years after an abdominal shot injury.

In floating kidney, pyelography constitutes the only method of examination giving an early evidence of existing disease. Congenital floating kidney generally has short ureters. The acquired form shows the ureters wavy and kinked. Renal tuberculosis is demonstrable by the roentgen ray only in advanced stages. The pyelogram shows a small renal pelvis, surrounded in the periphery by grape-shaped cavities, filled with contrast medium.The renal axis has a vertical position, and the ureter forms a straight broad band. Renal calculi which do not show many contrasts may be shown up better during pneumoperitoneum or oxygen insufflation. The pyelogram may show light areas in the renal pelvis filled with contrast medium; or the calculus may be impregnated with the contrast medium, and become visible after subsequent exposure following evacuation of the medium. In the pyelogram defects in filling are seen in cases of papilloma of the renal pelvis and in renal carcinoma, similar to those seen in gastric tumors. Ureteral catheters of small diameter must be used for ureter pyelograms in order to avoid artificial pathological pictures. It is best to employ contrast catheters. In order to demonstrate ureteral calculi in the small pelvis, stereoscopic pictures must be made. If ureteral insufficiency is suspected, the bladder only is filled with contrast medium, the urethra is closed, and the patient on the roentgen table exerts pressure upon the bladder as for micturition. An existing insufficiency will often cause considerable dilatation of the ureters.

BROOKS, BARNEY. Intraarterial injection of sodium iodid. *J. Am. M. Ass.*, Chicago, March 29, 1924, lxxxii, 1016–1019.

The fluid used is a sterile solution of 100 gm. of sodium iodid crystals in 100 c.c. of distilled water, which is used soon after preparation. It should be colorless or very faintly yellowish.

To obtain a roentgenogram of the arteries of the lower extremity, the entire thigh is prepared as if for operation. A sterile tourniquet is placed as high as possible, not tightened, under local anesthesia. The femoral artery is exposed

at the proximal end of Hunter's canal, and a Crile artery clamp is placed in position but not tightened. The roentgen tube is placed over the knee, a large photographic plate behind the knee, and the tourniquet is then tightened enough to fill the veins. The Crile clamp is then tightened sufficiently to occlude the artery entirely. After a short interval to allow the artery to empty its blood, a medium-sized needle is introduced. The roentgen picture is then taken (one of the foot and leg may be also taken if required). The wound is then dressed.

From 3 cases recorded and other clinical experiences and from animal experiments, this method has been found to give valuable information as to the location and extent of arterial obstructions. There has resulted no manifestation of injury to the artery from the injection. An exact knowledge of the site and extent of occlusion of the arteries is of great value in the prognosis and treatment of diseases of the extremities due to deficient arterial supply. This knowledge is of service in determining the necessity of amputation in peripheral gangrene, and in determining the site when amputation is required. It also has shown that conditions supposed to be due to arterial obstruction had other causes.

DESJARDINS, A. U. The present status of radiation therapy in cancer. *Journal-Lancet*, Feb. 15, 1924, xliv, 103–109.

Physicians who have seen many patients subjected to radiation have been struck by definite and sometimes astonishing effects on certain lesions. In certain cases of cancer, more or less complete regression of the tumor and a partial or complete restoration to health are not infrequent.

One of the outstanding characteristics of malignant tumor is the atypical and hyperactive metabolism of its cellular elements. Although the causes of such hypermitosis are unexplained, it is known that rate of mitosis determines the rate of the tumor growth. The cell is most sensitive to radiation during the period of mitosis. The difference between the rate of mitosis of the tumor cells and of the normal tissue cells is the essential basis for the application of roentgen and radium radiations in treatment of malignant lesions.

Neoplasms such as occur in Hodgkin's disease and lymphosarcoma are strikingly influenced by even small doses, while such as melano-epithelioma are seldom affected. Between these two extremes there are all grades of radiosensitiveness, corresponding more or less to the effect on normal tissue, to which the tumor is morphologically related. The relative sensitiveness may be roughly graded: teratoma, lymphoma, sarcoma, carcinoma or epithelioma (basal or squamous cell), epithelioma and melanoma. The tendency of sarcoma to early metastasis commonly removes all hope of a permanent cure, though a very considerable palliation for a time may be had. Carcinoma, and epithelioma of the basal cell type can be cured in about 90 per cent of cases. The reverse is true of the squamous cell type, with its greater tendency to differentiate and metastasize.

With adequate radiation the cells in metaphase will after a few days begin to show definite change, edema, disarrangement, clumping, disintegration, and scattering of the chromatin; vacuolization of protoplasm, rupture of cell wall, and replacement by newly formed connective tissue. In cells that have not reached, or have passed the metaphase, similar but incomplete changes occur, as is evidenced by more or less pronounced disturbance in mitosis, lowered metabolism, production of anomalous cell forms and more or less complete degeneration. An important effect of repeated sublethal doses is to increase the resistance of the cells, permitting the tumor to recover its power of growth. In any tumor, there are cells in different stages of metabolism, some in metaphase, some approaching it, some just past and others in the resting stage. A dose sufficient to destroy only the cells in metaphase may inhibit the activity of the others, but not permanently. This explains why most tumors are not permanently cured.

There is no essential difference in the action of radium and roentgen rays. In certain lesions the use of the one or the other is preferred, depending on the size, location and nature of the lesion and the available forms of the agents themselves. The beta and softer gamma rays of radium produce a marked caustic effect often leading to necrosis and sloughing. The tendency is to use platinum and gold filters to remove all of the beta and softer gamma rays of radium.

The surgeon who is content to save only one out of 5 cases of cancer of the breast, and is unwilling to try supplementary radiation; or insists on operation in cases of carcinoma of the cervix when radiation alone will give equally good results, may be left to his fate; and the same is true of the radiologist who does not recognize his limitations.

In cancer of the breast, surgeons knowing the possibilities of radiology, confine operations to cases in which the likelihood of complete excision of the malignant growth is clinically unquestionable. The more familiar he is with the effect of radiation in inoperable cases, the

less will he be tempted to interfere. Even when such intervention seems desirable the radiologist should be consulted. Inferior radiology may of course mar the effect of superior surgery almost as much as injudicious surgery spoils the most effective radiologic procedure. Radiation and surgery should be so planned and executed as to make them most effective. This is done by a preliminary roentgenization, not only of the region involved, but of the entire lymphatic drainage. The procedure should be repeated once or twice after operation, depending upon the degree of glandular involvement. One or 2 weeks should elapse between the preliminary radiation and the operation to allow for sufficient cellular change to minimize subsequent surgical dissemination. Unless the dosage is carried to extreme limits, no interference with wound healing should be noticed. In inoperable cases irradiation may so improve the condition that surgical amputation may seem feasible; but it often lights the process up again and so should be done only after serious consideration.

In curable cancers of the uterus the treatment should be pushed with vigor, and in the incurable the object must be to obtain the greatest possible improvement.

In lymphoblastoma irradiation is the only treatment which exerts notable influence. Many are restored to normal health. Even in extensive mediastinal glandular involvement with plural effusion, it is often possible to cause the adenopathy to disappear and the fluid to be absorbed. This improvement is not permanent but may endure for two or three years. Sooner or later there is a recurrence. Radiotherapy makes the patient more comfortable.

GUY, W. H. and JACOB, F. M. The erythema dose of radium. *Arch. Dermat. & Syph.*, Jan., 1924, ix, 73–81.

Owing to variable sensitiveness of the skin of different parts of the body, the scalp has been selected for exposure for the establishment of a unit for temporary and for permanent epilation (erythema dose).

Beta Ray Applications. The most important method of application is by the use of bare or lightly screened plaques. Different plaques of equivalent size and radium content varied in their beta ray activity, due probably to variations in thickness and composition of the holder. The reactions conform closely in outline to the shape of the applicator, the reaction being within certain limits proportional to milligram-hour dosage. With unscreened half-strength plaques, one minute sufficed for temporary erythema. Beginning at 6 minutes, a primary hyperpigmentation and later atrophy with depigmentation was produced only along the lines corresponding to the metallic edge of the applicator. This is probably caused by the thin layer of non-metallic substance removing the secondary rays. Interposition of 1 mm. of rubber prevented aggravated marginal reactions.

Half-strength plaques applied for 5 to 30 minutes produced erythema of corresponding intensity (30 minutes generally produced heavy reactions with depigmentation, telangiectasia and atrophy). It is suggested that half-strength plaques be applied for not more than 30 minutes when good cosmetic results are desired. The beta radiation of radium will be difficult to standardize. It was found that an erythema produced by beta rays on the scalp was not necessarily followed by even temporary epilation. Flat application for 10 minutes produced definite erythema, but did not cause epilation; 15 minutes produced temporary epilation, 30 minutes produced heavy reaction with exudation and permanent epilation.

Gamma Ray Applications. Tubes were screened with 0.5 mm. silver, 1 mm. brass and 1 mm. rubber. Interposed between plaques and the surface were 1.2 mm. brass and 1 mm. rubber. The minimum focal distance was nearly the same. It was not possible to draw definite conclusions as to minimum dosage for erythema, or the gradation of reaction corresponding with increased dosage. A second degree burn may be expected from the application of 200 mg.-hr. at 2.5 mm., and when cosmetic results are of importance, the dose should not exceed 150 mg.-hr. at the same distance.

Ten mg. of radium element in the form of half-strength flat applicators filtered with 1.2 mm. brass and 1 mm. rubber for 4 hours, did not produce a scalp erythema, but resulted in epilation in 21 days and regrowth 2 months later. Longer applications up to 7 hours produced epilation, and slower regrowth, 8 and 9 hours' exposure did not permit complete regrowth, while a 10-hour exposure resulted in permanent epilation and slight erythema.

JOPHER, GLOVER H. Demonstrations of spontaneous pneumoperitoneum by the roentgen ray. *J. Am. M. Ass., Chicago*, March 8, 1924, lxxxii, 781–783.

The perforation of a peptic ulcer may be acute or chronic, the former perforating freely into the general peritoneal cavity, the latter producing a localized peritonitis, and forming adhesions. Of 152 peptic ulcers observed, 104 were duodenal and 48 gastric; 12.5 per cent

were perforating peptic ulcers; and 2 patients had both duodenal and gastric ulcers. Acute perforation of both types occurred in 5.9 per cent. At times these acute cases are very difficult to diagnose, and the greater the delay in operation, the higher the mortality. The short time needed for roentgen-ray examination can well be spared for accuracy in obscure cases. The amount of free gas present is a factor in the ease of demonstration. In one case a differential diagnosis between acute appendicitis and perforating ulcer was made by demonstration of pneumoperitoneum.

JUNGMANN, E. Epicondylitis of the humerus. *Ergebn. d. Chir. u. Orthop., Berl.*, 1923, xvi, 155–164.

Roentgen examinations for epicondylitis humeri generally have a negative result. Periostitic thickening and proliferation may be demonstrated. The author cites one such case. Preiser has shown that the head of the radius shows up on the antero-dorsal roentgenogram, protruding from the lateral condyle of the humerus, while normally the contour of the lateral humeral condyle merges into the contour of the radial head. Etiologically and pathologically, the disease is not an entity. For this reason it is better to call the condition epicondylic pain.

PIERSOLL, CLAUDE E. Present *X*-ray and radium therapy. *Calif. State J. M., San Fran.*, January, 1924, xxii, 9–10.

The law of Bergonié and Tribondeau—"Immature cells and cells in an active state of division are more sensitive to the *X*-ray than are cells which have already acquired their fixed adult morphological or physiological characters"—applies also to radium. Insufficient doses of radium tend to render animal tissues hyperemic and stimulate growth rather than cell degeneration. The more highly differentiated the normal cells, the more resistant to the rays. Brain cells withstand heavier doses than any other tissues. The most conspicuous successes with radium have been attained in that class of disease manifested by hyperplasia of soft tissue.

Radium and roentgen radiation are the agents of first choice in four groups of cases: (1) angioma, birth-mark, leucoplakia, keloid, mole, wart, uterine fibroid and other non-malignant uterine hemorrhages; (2) in inoperable and postoperative cancer, Hodgkin's disease, lymphatic leucemia, and lymphosarcoma, radiation is used to give comfort, prolong life and give hope for an occasional cure; (3) all precancerous lesions, such as papilloma, pigmented mole, senile keratoses and leucoplakia, non-suppurative tuberculous adenitis, all premetastatic cancers (especially about the face) and cancers limited to cervix uteri; (4) leucorrhea, subacute and chronic, enlarged thymus in children, toxic goiter, chronic and hypertrophied tonsils, soft nasal polypi after surgical removal, cancer of the bladder, uterus or esophagus.

Radiation of cancer often stops the pain within a few hours. Small chronic lumps in the breast, chronic sore, fissure or induration should be treated as a cancer, without biopsy.

ROOS, E. C. Treatment of fibroids of the uterus. *Illinois M. J.*, January, 1924, xlv, 50–53.

In the last 20 cases radium was used in 10, and surgery in 10. One of the operative cases died on the fifth day with pulmonary embolus. In 8 of the 10 cases treated with radium the tumor had entirely disappeared in 6 months. The 2 fibroids which failed to disappear entirely were extremely large. The end-results were equally satisfactory in both groups. The operation mortality in fibroid of the uterus is from 3 to 5 per cent. The radium mortality is practically nil. The average hospital stay after radium is 5 days and after hysterectomy or myomectomy, from 18 to 21 days. There is much less pain and discomfort after radium than after operative treatment.

Irradiation is the treatment of choice for myomas which do not extend above the umbilicus in women approaching the menopause. The cases in which hemorrhage is a prominent symptom (the interstitial type) are those in which radium should be used. Poor surgical risks should also be irradiated. Radium should not be used in inflammatory conditions, or when there is a history of pelvic infection. Roentgen radiation may be used with the same results, but the dosage has not been sufficiently standardized to make this treatment as safe and as practical as radium therapy.

The fields of radium and surgery in treatment of cases are well defined and each case must be studied individually. There are definite contraindications to the use of radium in certain types of uterine fibroids and then surgery is indicated.